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A Battleship That Will Never Sail the Seven Seas

SURROUNDED by a group of naval officers and officials and in full view of thousands of spectators, Mrs. John Purroy Mitchel, wife of the Mayor of New York city, christened the battleship "Recruit" in Union Square Park as part of the Memorial Day exercises. As the bottle of champagne broke and the wine splashed in all directions, the dreadnought theoretically slid off the ways and plunged into the waters of one of the city's most important squares; for the "Recruit" is in the strictest sense of the word a land battleship, dedicated to the purpose of stimulating enlistments for the Navy and the Marine Corps.

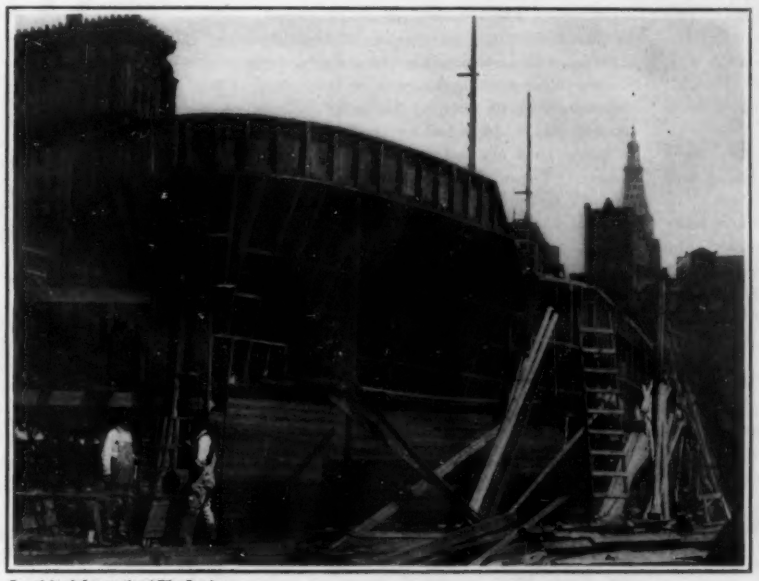
The "Recruit" is a wooden structure faithfully following the lines of an American dreadnought, with turrets, bigguns, skeleton masts, bridge and other features, and intended not only as a striking spectacle but as a practical recruiting office. The good ship measures 200 feet in length and 40 feet in beam, and being fully supplied with equipment that belongs to an armored vessel, the "Recruit" will not only offer ample quarters to the Navy and Marine Corps for recruiting, but will also serve some of the purposes of a training ship.

For weeks the workmen labored on the "Recruit," and the accompanying illustrations furnish some idea of their task. To give the craft the proper shape a careful framework was constructed, step by step, and then covered over with boards. With the hull once completed the numerous superstructural members, such as turrets and masts and funnel and bridge, were turned out or built up and mounted in their proper places. Aside from wood, tin was used to a large extent for the various parts of the ship. The larger guns were made of wood for obvious reasons; but mounted on the upper deck are real one-pounders whose operation can be studied by prospective recruits. Then, too, the "Recruit" carries a real searchlight and a real semaphore signalling equipment, together with the usual lights. All the work of construction was carried on in the presence of thousands of people passing through the park each day. With its coat of regulation war gray the land battleship is most realistic in appearance.

In the hull of the wooden dreadnought there is ample room for the offices of the recruiting officials. The doors are located along the sides, and the usual portholes furnish daylight and ventilation. All in all, the wooden battleship should prove an effective recruiting device.

On behalf of the city and the Mayor's Committee on National Defense, which had undertaken the construction of the vessel for recruiting purposes, Mayor Mitchel formally presented the "Recruit" to the Navy. Rear Admiral Usher, representing the department, received the battleship. In his presentation address Mayor Mitchel called attention to New York's comparatively poor recruiting record, and said that the people must now be aroused to the seriousness of the duty which confronts them.

"At the beginning of the great war," said the Mayor, "farsighted men saw the inevitability of the United States entering the conflict. The City Government long ago began to prepare against that day when the declaration of war would compel us to take up arms. In every way possible the City Government has endeavored to assist the National Government in raising men for the Army, Navy and Marines. The construction of this model is merely one expression of that effort"



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Bow of the wooden dreadnought "Recruit" in building, showing the elaborate framework and covering

Electrolytic Iron for Commercial Use

THE earliest researches made with the object of producing pure iron by the electrolysis of solutions of ferric salts were made by Muller and Burgess, but were not attended by industrial application. Later experiments along this line have been conducted by Fischer, in Germany, by the Langheim-Pfankauser Works in Switzerland, by Boucher and the *Société Le Fer* in France, and at the University of Illinois in this country.

It is now announced that the great Iron Association of France mentioned above, *La Société Le Fer*, has succeeded in producing electrolytic iron on so large a scale, in great retorts absorbing as high as 20,000 amperes, that it is to be used immediately for the commercial manufacture of iron pipes, etc., on an extensive scale. Indeed, it is stated by the *Journal du four électrique et de l'électrotyse* that the Bouchayer and Viallet Works at Grenoble, which hold a concession of the Society's patents have already commenced the manufacture of pipes of large size from electrolytic iron. These are 4 meters long, 100 to 200 millimeters in diameter, and 1.5 millimeters in thickness (13 feet long, 3.9 inches to 7.8 inches in diameter, .0585 millimeters in thickness).

These tubes are employed for various industrial uses, such as conduits for water, steam, or compressed air. They have thus given entire satisfaction in practical use. In manufacturing they are once annealed and reheated (une fois recuit) at considerable pressure. Such a tube of electrolytic iron is said to possess the same resistance to pressure as a tube of cast iron (la fonte) 20 times as thick.

The electrolytic iron obtained by this new process is said to be entirely different from ordinary iron both in aspect and in properties. From the magnetic point of view it is possessed of a very great permeability and a low degree of hysteresis, making it particularly valuable for the manufacture of motors and transformers; from the mechanical point of view it possesses high resistance and a considerable degree of extension.

No secret is made of the fact that these tubes are expected to replace successfully the German tubes of which Mannesmann held a monopoly before the war. The manufacture of thin sheet iron (toles mince) will probably be undertaken by the Foundries and Forges of Ste. Marie and Gravisny.

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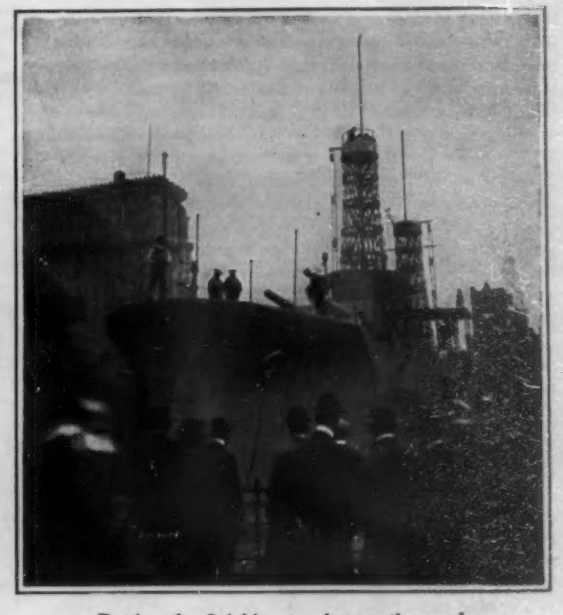
Hull of New York's battleship "Recruit." This odd wooden ship is at once a striking spectacle and a practical recruiting office



Putting the finishing touches on the good ship "Recruit"

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

The Gun Accident on the "Mongolia"

IT would be most unfortunate if the fatal accident on the "Mongolia" should have the effect of shaking the confidence of the public, to say nothing of our enlisted men, in the quality of the ammunition which is being served out to the gun crews on our ships. The men who serve the guns understand, of course, that the death of the two nurses, tragic and deplorable as it was, resulted from an accident of such an unusual and "freak" character, that the possibility of such an accident happening again is very remote.

The pieces of metal which caused the fatality were fragments of a brass cup which is used for closing and keeping air-and-moisture proof the powder charge. In the guns mounted on the "Mongolia" the shell and powder are not carried in one cartridge, but are loaded into the gun separately. The powder is contained in a brass cylinder of the same diameter as the powder chamber, into which it fits snugly. Its forward end is closed by a brass cup, which, when the gun is loaded, lies next to the base of the shell.

When the gun is fired, the powder gases exert a pressure of eighteen to twenty tons on every square inch of the interior of the powder chamber; and hence the six-inch plate is forced against the base of the shell with a total pressure of over five hundred tons. Under the enormous frictional resistance and because of the rifling, the plate will rotate with the shell, and as it issues from the muzzle its periphery will be spinning at the speed of about fifteen hundred feet per second.

Now mark the conditions. As soon as the flat face of the cup is clear of the muzzle and while the flange of the cup is still supported by the bore of the gun, a portion of the flange will be exposed to the full bursting pressure (say about eight tons to the square inch), and will be ruptured, the whole cup breaking up into fragments. Since the cup is rotating at a speed, at its circumference, of 1,500 feet per second, the fragments will tend to fly off at right angles to the trajectory of the shell; but because the fragments also have a forward velocity of 3,000 feet per second, their line of flight would be say about thirty degrees from the line of flight of the shell. This consideration will partly explain how the pieces of a cup that was fired from a gun trained only a little forward of the beam of the ship could have travelled at right angles to the line of flight and struck persons that were seated on an upper deck and 175 feet away from the gun.

The main contributory cause, however, was the lateral rush of the gases as they mushroomed on escaping from the muzzle of the gun. To understand this it must be remembered that immediately the base of the shell leaves the gun the velocity of the escaping gases is over 30,000 feet per second (Maxim), and that these gases escape at this velocity not merely in the direction of the shell but laterally as well. It is quite conceivable that this lateral rush of the gases coupled with the centrifugal effect would suffice to carry the fragments with high velocity in a direction at right angles to the axis of the gun. The means adopted by the Bureau of Ordnance to prevent a repetition of any such accident is the very simple one of substituting a cap of wood or fibrous material for the metal cap hitherto used.

If it be true that several shells have burst in the guns on some of our ships, this is another and most serious matter calling for thorough investigation.

Manning Our Merchant Marine

WHEN the plan was announced recently that this country could turn out a thousand ships per year to replace vessels destroyed by submarines, the general public applauded the proposal without giving much thought to the details involved. It has probably escaped the attention of the casual reader that one of the principal obstacles yet to be overcome is that of providing sufficient crews to man these boats. This, however, is a matter that has been given a great deal of consideration, and we have on the Shipping Board in addition to the Director of Construction and Director of Transportation, a Director of Recruiting, whose task it is to provide officers to operate the vessels.

Each ship will probably require four deck officers, a captain and three mates; in the engine room there will have to be a chief engineer and three assistants, making a total of at least eight trained men per ship. The number would vary, of course, with the size of the vessels, but this may be taken as a standard. These men will be needed soon. Inside of a year we must have 8,000 trained men to operate the new ships. In addition to these ships there are many, now nearing completion, that are being built for other governments and for private concerns, which will be taken over by our Government. This will raise our requirements to between 9,000 and 10,000 men.

The plan of the Director of Recruiting is to establish schools of navigation along the New England coast. There are several existing schools in New York so that this city is not now included in the campaign. As the work develops, schools may be established farther down the coast of the Atlantic, and then in the Gulf ports, and finally on the Pacific Coast. At these schools the plan is to enroll seamen; that is, men with considerable maritime experience, but who either have no knowledge of navigation or else have been so long removed from actual contact with navigation as to have become rusty in its practice. The schools are to be established right where the seamen are to be found. Thus it will be possible for the men to spend their evenings in these schools, while conducting their daily work at the same time. After serving a course in the school of navigation the men will be entered as petty officers on coastwise vessels and vessels sailing to South American ports or to lands that are not embraced in the submarine zone. Similarly the engineers will be educated in well-equipped schools, and as they are graduated will be given practical training as assistant engineers on coastwise vessels. Thus they will be thoroughly equipped for service across the Atlantic.

The result of this training will be the establishment of a fine body of trained men whose services to our country and to our allies will be immeasurable during the present war, and who, after the war is over, will maintain an efficient American merchant marine.

Generals of Industry

EVER since the war started we have been hearing of American inefficiency. Our frightful wastefulness of materials, lavish expenditure of money, our disjointed efforts due to individualism, and the time-consuming operations of our Government, both national and state, have furnished texts for many lectures and papers. The example that Germany set before us at the very outset of the great conflict was a revelation, and as the war proceeded the value of efficiency was forced upon us. We witnessed the struggle of Great Britain with inefficient systems similar to our own, and realized all the more the importance of remodeling our own mode of living and system of work. And yet, strange as it may seem, the science of efficiency had its origin in this country. It is a young science which has not been received as it should in the land of its birth, but has actually made greater progress abroad. Our industrial engineers were met with some distrust in Germany when they first traveled to that land to preach their gospel of efficiency, but later they were received with open arms, and American efficiency methods were eagerly introduced into the industrial life of the land. In England the same opposition was met and it persisted, until the present war showed our cousins across the water that in a great conflict of nations, that nation will succeed which makes best use of efficient methods of production.

Now we ourselves have entered the conflict, and in this land, the home of scientific management, we are coming to realize the importance of this science. Its value has not yet been appreciated by the mass of the public. We are still so prejudiced by the mistakes of efficiency engineers when the science was young that we are wont to think of it as largely a failure. A great campaign of education is necessary to teach the American public the importance of industrial efficiency methods. It is significant that, on the Naval Consulting Board, there are no representatives of scientific management, nor are such representatives to be found on the Council of National Defense. However, an appeal has come from the latter body for the assistance of industrial engineers. At the recent annual meeting of the Western Efficiency Society, in Chicago, a letter was read from one of the members of the Council of National Defense, asking for the coöperation of the industrial engineers of this country.

Strangely enough there was no national organization of industrial engineers for the Council of National Defense to call upon. The efficiency societies have been local organizations, each looking after its own particular field of activity. At the conference of the Western Efficiency Society, however, it was decided to establish a national organization which would be concerned with the broader movement for the national standardization of the principles and fundamentals of industrial management.

This society has just been formed, and one of its principal objects in the present emergency is to offer its services to the Government in order to make national expenditures of effort, money and materials more efficient. By having a national organization to deal with, the Council of National Defense may be assured of a more direct contact with men who are skilled in efficient industrial organization.

It has frequently been pointed out that the present war is being fought out largely in the machine shop; that the man at the lathe is performing a service for the country that is not second to that of the man in the trench. This being the case, we must not fail to mobilize the "generals of industry," those men who have made a careful study of industrial methods, and have developed efficient plans for the utilization of human and mechanical effort. While this country is a land of peace, and we do not number many military men among us, our industrial resources are greater than those of any other nation, and if properly generaled by skilled industrial engineers, the part that we are to play in the great war should be a decisive one.

The Aladdin's Cave of the Dye Industry

WITH the development of famine conditions in our dye industries during the first year of the war came the question of what products we have in America which could be utilized for the manufacture of dyes. This problem has been put before the nation's chemists and to many of its phases answers have been found. Not the least interesting of these is one recently reported from Milwaukee.

A certain coke-making concern with headquarters there had been for years dumping into Lake Michigan its slag and other refuse, supposing this stuff to be quite worthless. It chanced that there resided in Milwaukee a dye chemist of wide experience in Germany and England. Well acquainted with the treasured secrets of the German dye-makers, he set himself the task of finding raw materials forming a potential basis for an American dye industry. The submarine coke dump came to his attention; and in spite of the known fact that the dye bases of Germany and England were of different composition, he went to work on this material.

After considerable experimenting he succeeded in producing a dye from the slag. The possibilities were brought to the attention of the coke company's officials. While these gentlemen did not take the work very seriously, they were sufficiently interested to make arrangements for further experiments. A small quantity of dye was produced which compared favorably with the finest German colors. The experiments developed to greater proportions, until at length the company became enthusiastic, and gave the project full confidence.

A farm of 120 acres was purchased along the Lake shore, about six miles south of Milwaukee. A fund of two millions was laid aside to finance the scheme, and building operations began on a large scale in January, 1916. Within the year fourteen large structures had been put up, and the payroll of the new dye works included several hundred men. Well-known chemists from near and far have been engaged to give their services to the further development of the project so admirably begun; and the company officials, at first perhaps even more indifferent than the average business man to the claim that science can help out in the industries, have become red-hot advocates of the industrial research idea.

All of the chemical formulae are withheld from patent and kept strictly secret, and in most of the company's buildings none but employees are allowed to enter. The success of the business lies in the distilling system, perfected at an expense of many thousands of dollars. To keep the plant running at full capacity three 8-hour shifts of chemists are employed to keep tabs on the finished product and on the raw materials which are fed by the coke factory to the dye factory—in addition to the regular staff of analytical men engaged in constant experiment. The large amount of refuse formerly dumped into the lake now goes in its entirety to the making of dyes.

That even yet there is plenty of room for improvement in the processes employed is indicated by the fact that each month the company's inspecting chemists reject thousands of pounds of finished dyes which fail to meet the standards imposed, either as regards solubility or with respect to melting point. No chances are taken; each run of the stills is analyzed and tested as carefully as though it were the result of first experiments.

The dye comes from the stills in a molten mass, which is run off into pails and cooled until it crystalizes. It is then taken out of the pails in big chunks and packed in barrels. These contain about 360 pounds of dye, selling for an average of $1.25 a pound. The building up of such an industry, founded entirely upon preventable waste, is but an indication of what we may be able to do with proper scientific organization of our business.

Electricity

Wireless Installations for Spanish Ships.—A royal order, published March 1st, provides that all Spanish merchant vessels of 500 tons or more devoted to either the ocean or the coastwise trade shall be provided with wireless telegraph apparatus of a minimum strength of 100 miles. Such vessels must also carry one or more motor lifeboats, according to the number of the crew, or be provided with motors which could be adjusted if necessary to ordinary lifeboats.

Dust and Electric Current Consumption.—A coat of dust on the transparent types of shades and reflectors is bound to have a material effect on the electric light bill; for it requires far greater current consumption to illuminate a room in which dusty reflectors and shades are in service than one where the shades are clean. Large consumers of illuminating current long ago learnt this lesson, and in consequence keep their reflectors and shades as near spotless as possible.

Doing Without German Porcelain.—Writing recently in the *Revue Générale de l'Electricité*, R. Legouez refers to the rapid development of the manufacture of porcelain materials for electrical work in France. Previous to the outbreak of war France purchased 500 metric tons of porcelain accessories from Germany per annum. Already this amount is being manufactured at home, and the larger works hope soon to be in a position to become exporters of such material. An inquiry addressed to seven works showed that a production of 5,000 tons of electrical porcelain products had been attained; contracts already carried out or in course of execution reached 7,000 tons, and very soon the extensions in progress will enable an output of 9,300 tons to be counted upon.

Methods of Suspension on Italian Electric Railways.—Electric traction on the Italian railways has made great strides of late, a feature of which, commented on in *Engineering*, is the complete standardization of apparatus. Thus on a total of 700 km. (435 miles) of electrified line, haulage is effected by a single type of engine. Italy has also specialized by selecting from the longitudinal and cross-suspension systems concurrent in Europe and America, one system, the cross-suspension only. This method is particularly applicable in view of the mountainous nature of much of the country traversed, and on the Valtellina railway, which was the first to adopt high-tension three-phase current, involving two contact lines under different voltages, has distinct advantages.

An Electric Motor Chair.—An American firm is now engaged in making electric-motor chairs with either 150-ampere hour or 200-ampere hour batteries. The former, when fully charged, will give five hours of continuous running service, while the latter will give seven hours, according to the designer. The batteries are of the 12-volt type and the motor is designed to develop 0.5 to 2 horsepower according to the load. The motor is geared directly to the axle of the front wheel with a triple worm which permits the motor to propel the car up a 15 per cent grade when loaded with two adults. Extending in front of the car is a guard which breaks the circuit between the batteries and motor and applies the brake when it comes in contact with any obstacle.

Electrical Testing of Acid Resistance of Paints.—In connection with investigations in the production of an improved acidproof enamel, an English firm has evolved what it claims to be a new and rapid, as well as a simple and reliable, method of testing the acid resistance of enamels, paints and varnishes. The principle of the test is that of the voltaic cell. Plates or rods of dissimilar metals, say copper and zinc, are coated with the enamel or material to be tested and immersed in dilute acid, when if they are unable to withstand the corrosive action of the acid a breakdown occurs, galvanic action setting in is recorded by suitable instruments, and its density forms the basis of comparison of the acid-resisting properties of the coating. The test, it is obvious to those familiar with electricity, is ingenious; but its practicability is probably quite another matter.

Electric Treatment of the Wounded is gaining ground rapidly, according to the statements of Dr. Turrell writing in the *Lancet*. "We make use," he states, "of large pads, strong currents, and seances of as long duration as the time of the department will permit. Cases treated in this way include subacute and chronic rheumatism, some cases of neuritis, septic and indolent wounds, stiff joints, etc. Where the limitation of movement in a stiff joint is due to fibrous bands or adhesions, ionization is often very useful; in these cases massage and manipulation should be performed as soon as possible after the conclusion of the electrical seance. The ionic medication of foul, extensive and sloughing wounds with the chlorin ion quickly allays the odor and leads to rapid healing with smooth, flexible scars and free movement in the surrounding tissues. I believe that this class of case is far too rarely sent to the electrical department for treatment."

Science

American Gray Squirrels, introduced into Richmond Park, near London, have spread into the adjacent country and proved such a pest that the authorities are taking measures to exterminate them. They not only drive away the native red squirrel, but work great damage in gardens and orchards.

Municipal Departments of Weights and Measures may obtain, on request, from the U. S. Bureau of Standards in Washington material for drafting ordinances relating to weights and measures and suggestions as to methods of operation. Service of this character has recently been rendered by the Bureau to a number of cities in various parts of the country.

Potash from Banana Stalks and Skins.—One of the many plants recently suggested as a source of potash is the banana. Mr. R. H. Ellis reports in the *Journal* of the Society of Chemical Industry, London, analyses of banana stalks indicating that a ton of stalks yielded 188 pounds of dry matter, containing 13.7 per cent potash; or about two-thirds as much as is yielded by the dried kelp of our Pacific coast. An examination of banana skins showed a total potash content of 1.05 per cent, the dry matter containing 9.03 per cent potash.

Investigation of Ptomaine Poisoning.—It is announced that the sum of $20,000 a year, for a period of three years, has been offered to Harvard University by the National Canners' Association to defray the expense of an investigation of food poisoning or so-called ptomaine poisoning, with special reference to canned goods. In accepting the offer the university reserves entire academic freedom in the conduct of the investigation and the publication of results. The work will be done at the Harvard Medical School under the direction of Dr. M. J. Rosenau.

A New Method of Rooting Date Palm Offshoots has been developed by Mr. B. Drummond, of the U. S. Bureau of Plant Industry, and J. Northrop, of Indio, Cal. It consists essentially in the use of a propagating house covered with canvas instead of glass, and having no ventilation. This device prevents excessive drying by wind and sun and maintains a rather high humidity about the plants, together with a high temperature. Many old offshoots, which had been set in the field for one or even two years and had shown no signs of life, after being placed in these canvas houses threw out large fresh green leaves and vigorous roots within six or eight weeks.

Lumbang Nuts in the Philippines.—The Bureau of Agriculture in the Philippines has been making efforts to develop the lumbang, or candlenut, industry in the islands, and to encourage the planting of trees to replace the wild trees, which are being extensively destroyed. Mr. A. W. Prautch, an expert of the Bureau, has made a study of this industry for some years. At present, it is conducted in a very haphazard manner, the collecting being done chiefly by the wild tribes and the trade being conducted by Chinese. Most of the nuts that reach Manila come from Mindanao. The soft-shelled variety is the one that offers the best possibilities of development for commercial purposes. Lumbang-oil is used as an illuminant, in painting, and for calking.

Platinum in Spain.—A preliminary investigation of the platinum deposits in the mountainous region of southern Spain known as the Serranía de Ronda, begun in 1915, has recently been completed and the results have been published by the Geological Institute, in Madrid. It is stated that the area of the platiniferous zone is undoubtedly very large, there being twelve or fourteen wide rivers with extensive beds of platiniferous material. These could be dredged for platinum gravel for many years, if it is proved that the average platinum content of the gravel is sufficient to warrant the working. Some very rich zones were found. The Spanish Government has now undertaken an exhaustive investigation of the region.

The Crocker Land Expedition.—News of the safety of all members of this enterprise reached New York on May 29th, in the form of a cablegram from the Faroe Islands. The sender, Dr. H. J. Hunt, is on his way to Copenhagen aboard the Danish government ship "Hans Egede," which has figured in so many circum-polar exploits.

As is not unusual in such cases, the expedition appears to have been rather disrupted during its stay in the Arctic. Donald MacMillan, the leader, with several other members, is at Etah, on the northwest coast of Greenland, made famous by Peary's repeated use of it for a base; one of the relief vessels sent out is in North Star Bay; and the expedition's geologist, W. E. Ekblaw, is alone at Godhavn, South Greenland.

As reported in 1914, the expedition has established its belief that Crocker Land, which Peary suspected he had seen from Cape Thomas Hubbard on his return from the pole, has no real existence, and that the Admiral's observations were of a mirage. In addition to this, a great deal of valuable geographic, geological and anthropological data has been secured.

Automobile

Orphan Cars.—Few people realize how many different cars are still in use whose makers have gone out of business, and how many models of existing builders that are so far obsolete that spare parts are no longer carried at the factories of their origin. The *Horseless Age* recently published a list of 206 orphan cars, and is not entirely sure that it includes all of the tribe.

Recording Performance.—Instrument makers have made surprising progress in recording the performance of cars. An indicater recently introduced not only automatically shows the speed of the car, but records trip and season mileage and the mileage of the four tires in service and two spare tires. There are also hand-operated dials that keep account of the amount of oil and gasoline used during the season.

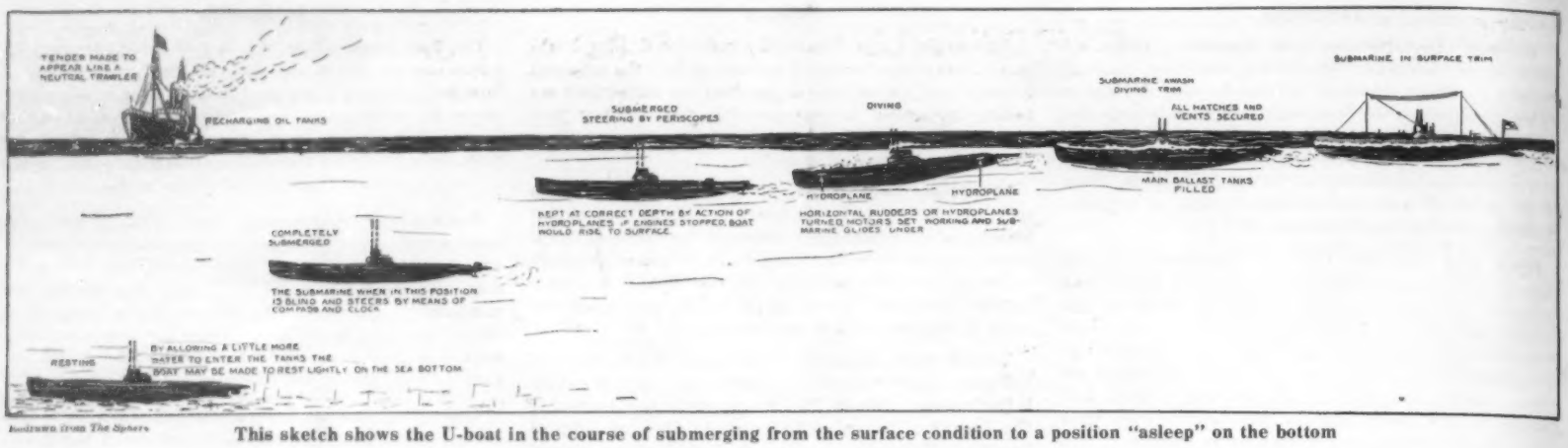
Guarding Against Lubrication Failure.—An Italian invention that contains much promise of usefulness, in connection with internal combustion motors provided with forced lubrication, is an arrangement that short circuits the ignition current when the lubrication fails. It is provided with a device for putting it out of action when it is desired to start the engine, when of course there is no oil pressure; and as soon as the oil pressure is raised to the normal point this starting device automatically becomes inoperative.

Heavy Vehicles on City Streets.—Comment has heretofore been made in this column in regard to the operation of heavy motor vehicles, attention being directed to the damage they cause to the road surface. The matter has recently been brought to public attention in London in another form, and it is proposed to limit the weight of such cars, because of the damage and annoyance from noise, vibration, etc. The problem is one that is sure to become more insistent as commercial vehicles building progresses, and should be carefully considered by manufacturers of such cars.

An Elusive Engine Trouble.—A simple defect that has caused many a car owner much worry and hours of fruitless investigation results from a dirty distributer or collector ring. It is natural that in the course of time dirt should accumulate on these parts, and when it does the result is ignition troubles that are difficult to locate, as there is no easily recognized symptom that is characteristic. It may cause a knock, or any one of a number of varieties of irregular firing. These parts should be carefully wiped at frequent intervals, and in doing this no metal tool should be used. If it is necessary to use some implement to reach narrow spaces with the wiping cloth, a soft piece of wood should be employed.

Automobile Advertising.—The character of a large proportion of the automobile advertising now appearing is beginning to attract criticism, and justly so, on account of the sweeping claims made of absolute and exclusive perfection; while everyone knows that the average purchaser could pick at random any one of a large number of prominent makes, with perfect certainty of getting a satisfactory car. This kind of advertising has been of gradual growth, resulting from the desire of each advertising writer to out-talk his neighbor, until some of the statements made read too much like the announcements of the professional promotor of fake enterprises. One vital reason for this condition is a lack of coöperation between the publicity and the engineering departments, for the designer of the car can easily give the ad-writer many unquestionable talking points that could be incorporated in forceful and unimpeachable advertisements; and there are enough special features to arouse the interest of the most critical buyer. An overdrawn and overworded advertisement arouses suspicion, and too much care cannot be taken to guard the dignity and credit of a reputable product.

Time for a Simple Automobile.—Year by year the mechanism of an automobile has become more complicated, until the car of today is a most wonderful and intricate aggregation of ingenious mechanisms. A plausible reason for the presence of each of these mechanisms can probably be given, although in many cases the real reason is, to furnish the sales department with "talking points"; nevertheless they undoubtedly, as a whole contribute to the convenience and efficiency of the car, and are satisfactory to owners who employ an expert driver, and keep a competent garage man to assist in cleaning and repairs. The great majority of the car-owning public, however, does not belong to this class, but are men of moderate means who drive and care for their own cars; they are not mechanics, and have neither the time nor the ability to keep a complicated car in good order, and in building a car for such users the important point to be kept constantly in mind is simplicity and a method of construction that will require a minimum of attention. A car medium priced, built to such specifications should be popular for its convenience and reliability, and economy of upkeep would more than offset the absence of a host of faddish auxiliary attachments and refinements.



Illustrations from *The Sphere*

This sketch shows the U-boat in the course of submerging from the surface condition to a position "asleep" on the bottom

Submarine Problem—II

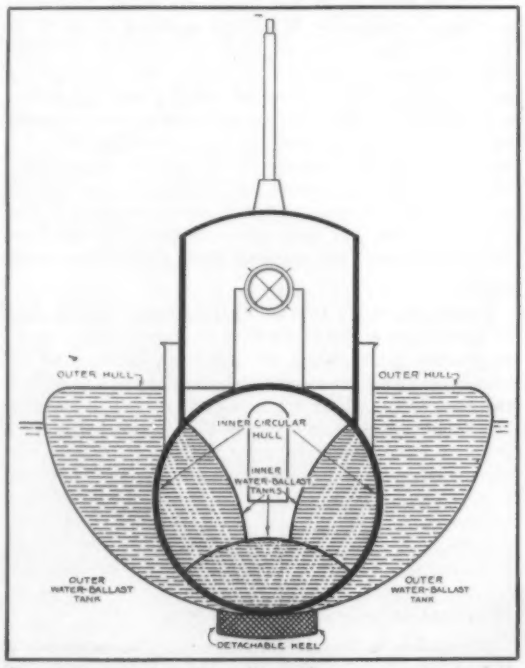
Internal Construction and Operation of the German U-Boat

BROADLY speaking, there are two types of submarine—one in which the cigar-shaped structure constitutes practically the whole of the boat; and the other, a double-hull structure, consisting of an inner, cylindrical, pressure-resisting portion, and an outer and much lighter hull built around the inner hull, which is more or less open to the sea and is not subjected to crushing pressure when the boat submerges. To the former class belongs the Holland type, as used in our own and the British navies, and in the latter class are included the Lake type, as used to a certain extent in our Navy and as adopted in a modified form by the Germans in their U-boats, and also the Italian Laurenti and the French Laubeuf designs. It should be noted, however, that in the Holland type as developed in our own and the British navies, a light exterior deck structure is built upon the cigar-shaped hull proper, and in the newer types this has been enlarged and extended until the later boats may be said to be a combination of the Holland and Lake ideas.

THIS is the second article in a series on the Submarine Problem, which will appear in successive issues of the SCIENTIFIC AMERICAN. The first of the series appeared in our last issue, (June 2nd), under the title "The Modern Automobile Torpedo".—EDITOR.

Construction of German U-Boat

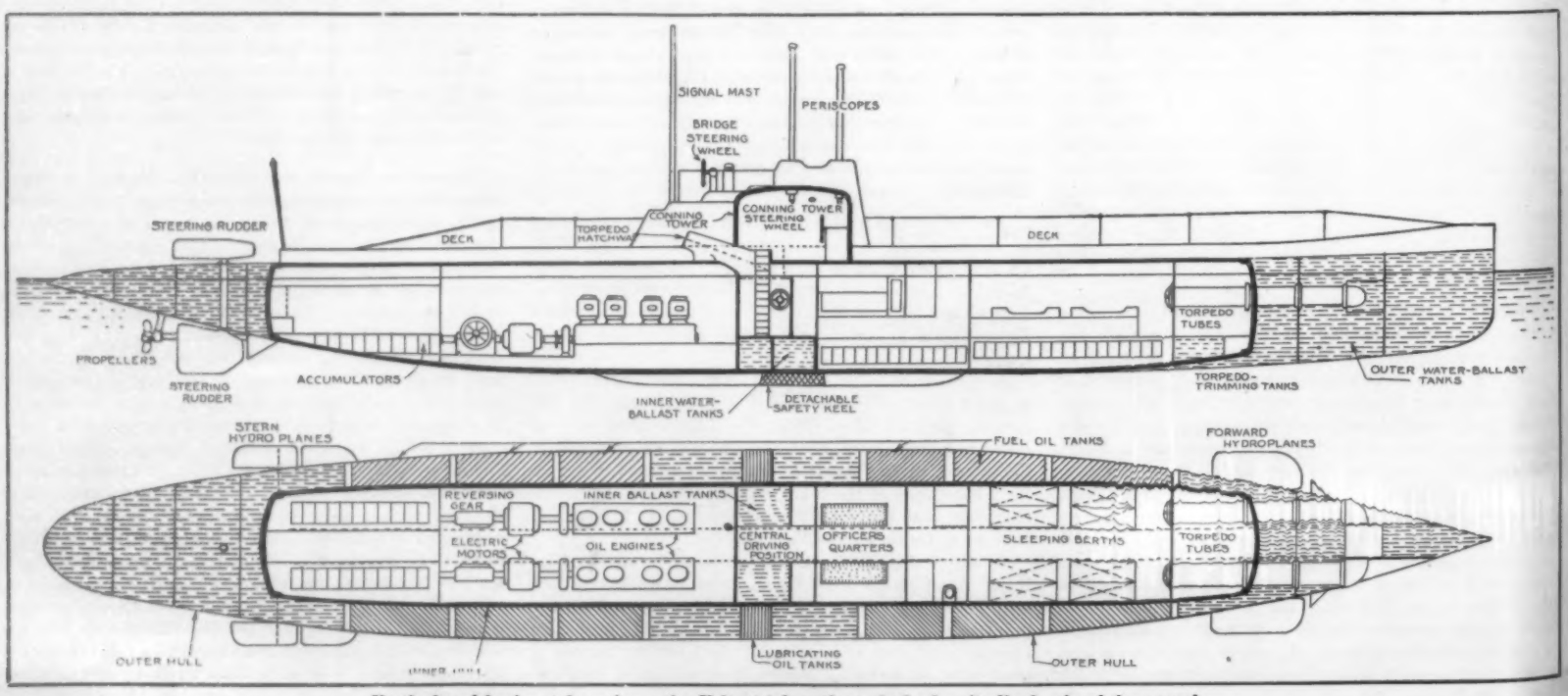
We present three drawings which show very clearly the construction of the German U-boat. It consists of an interior, pressure-resisting hull, circular in cross-section, which is shown in the drawings by heavy lines. This hull is of very strong construction, heavily framed and divided transversely by several water-tight bulkheads. It extends for about two-thirds of the length of the boat, its ends being closed by strong dished bulkheads. Above the center of this hull and formed integrally with it, is a conning tower, which, in the latest German boats, is protected with from two and one-half to three inches of armor. Around the boat proper is built an outer hull, which, being open to the sea, and therefore not subjected to hydrostatic pressure, is constructed of relatively light plating. This hull is of a form approximate to that of a surface ship and is designed to give the vessel a fair freeboard and a suitable form for driving at high speed on the surface. At the bow and at the stern, as in all submarines, are trimming tanks, which are utilized to bring the vessel to the proper fore-and-aft trim for diving. At the center of the pressure-resisting hull are the main and auxiliary ballast tanks, which are used for destroying the bouyancy of the boat and bringing it to the submerged condition ready for submergence. It should be explained that although the diagrams here shown are of one of the smaller and slower U-boats which Germany possessed at the opening of the war, they will serve to illustrate the construction and the principles of operation of the later boats of 800 tons with which the Germans have been doing most of their effective work.



Transverse section through conning tower, showing the interior (circular) pressure-resisting hull and the lighter exterior hull, which is open to the sea

Construction of the Inner Hull

Forward, at the bow of the inner hull, and opening into the torpedo compartment, is the torpedo room, from which the torpedo tubes pass through to openings in the outer shell. They are closed by doors which can be opened when torpedoes are to be fired. In the foremost compartment and below the inner portion of the tubes are the torpedo trimming tanks, into which a certain amount of water equal in weight to the weight of the torpedo discharged, is admitted to correct the trim. These are necessary for the reason that when the torpedo is discharged the bow is relieved of a weight of from one to two thousand pounds, according to the size of the torpedo, and if water were not admitted the bow would instantly begin to rise. In the torpedo-room compartment are the berthing and living accommodations for the crew. Aft of this is the compartment given up to officers' quarters. Then follows a relatively small compartment known as the operating room, which is located immediately below the conning tower with which it communicates by ladder and from which it can be shut off by a watertight hatch, so that if the conning tower should be destroyed by a shell the admission of water to the hull below will be prevented. Abaft of the operating room is the engine room containing a pair of heavy oil engines with clutch connections to a pair of electric motors. In the after end of the inner hull is a compartment which is given up to various machinery for operating the ship



Vertical and horizontal sections of a U-boat taken through the longitudinal axis of the vessel

and the storage of provisions, spare parts, etc. Built around and above the conning tower is the bridge which is used for navigating at the surface. It contains a telltale repeater which is connected with the gyroscopic compass within the hull and also a steering wheel. Extending centrally from above the after end of the inner hull up to the bow is a flush deck which, when the boat is running at the surface, is from three to four feet above the water.

The steering of the vessel in a horizontal plane is done by means of a double vertical rudder of large area and great power. Steering in a vertical plane under submerged conditions is accomplished by means of two pairs of hydroplanes, one pair at the after end of the boat and one forward.

How the Boat is Submerged

Just here we introduce some definitions of a few of the terms which are used in describing submarines:

Positive Buoyancy.—That condition in which a boat, any part of the structure of which is above water, requires ballast to sink.

Negative Buoyancy.—That condition in which a submerged boat without headway requires the removal of ballast to rise.

Neutral State.—That condition in which a completely submerged vessel is in equilibrium.

Submerged Trim.—The amount of positive or negative buoyancy a vessel possesses with reference to the neutral state.

Awash Condition.—That condition in which the main ballast tanks are empty and the auxiliary ballast and trimming tanks contain the requisite ballast so that by flooding the main ballast tanks the vessel will have the proper trim for submerged operations.

Flooding.—That process whereby water is admitted to a tank directly from the sea.

Filling.—That process whereby water is pumped into a tank.

Blowing.—That process whereby water is forced out of a tank by means of air pressure.

Pumping.—Pumping water overboard from the tanks by means of main or auxiliary pumps.

The boat is brought into the proper position for diving as follows: First, by means of the fore and aft trimming tanks, she is brought to the desired trim. Then the main ballast tanks which are within the circular hull amidship are flooded by opening large Kingston valves, the operation requiring from one to two minutes. There is a large volume of air in the ballast tanks that must be freed before the tanks can fill with water, and the process of getting rid of this air is called "venting." The main ballast tanks "vent" overboard, as the large volume of air, if admitted into the interior of the boat, would cause the barometric pressure in the boat to rise to such a point as to be uncomfortable. All the other tanks, being comparatively small, vent inboard.

The boat being trimmed down as far as the main deck, still has too much buoyancy to run submerged. The tank next flooded is the auxiliary ballast tank. This tank holds enough water to destroy the remaining buoyancy and is flooded generally until the top of the conning tower is just under the surface of the water. The final trimming is done by slowly flooding or filling the adjusting tank. When the vessel is trimmed until there is about two or three hundred pounds of positive buoyancy, it can be readily handled submerged. This is considered the best trim for all around work, and completes the static dive. From this condition any operation submerged can be commenced.

Meanwhile it will be understood that everybody has gone below and that the watertight hatch leading to the conning tower and the hatch leading from the conning tower to the hull have been closed. The oil engines are stopped and disconnected and the electric motors are started. Since the boat possesses only a small positive buoyancy of a few hundred pounds, as noted above, it will be understood that by the manipulation of the hydroplanes the vessel can be forced below water. She can be sent down either on a level keel or inclined by the head. In the former case, both the forward and aft rudders will be given a downward inclination and the rush of water against the upper surface of the planes will exert a heavy downward thrust pushing the ship bodily to the desired depth—or she may dive by depressing the aft and raising the forward rudders, in which case she will descend with inclination of a few degrees.

Turning to our description of the hull, it should be noted that the space around the ship between the outer and inner hulls is divided by a series of transverse water-tight bulkheads, and that several of these are utilized for carrying fuel oil. This can be done, although these outer compartments are not strong enough to resist hydrostatic pressure and are therefore open to the sea. That fuel can be carried in these outer tanks is due to the fact that oil is lighter than water. In the bottom of each oil tank is a valve opening to the sea, which allows the water pressure to act on the oil and thus insures that even at the greatest depths there will be the same pressure existing within as there is outside of the tank.

The public has been so often told that the submarine is an exceedingly delicate structure, liable to be sunk by the slightest blow from a surface boat or by a shell from a one-pounder gun, that it is time this misconception was removed. The submarine in its early form consisted of a single shell with few if any interior bulkheads and it was an extremely delicate affair; but it will be seen that these German U-boats receive a large measure of protection from the outer false hull, which can be badly penetrated or shot to pieces without affecting the stability or the flotation of the inner water-tight hull. Hence, when a destroyer or a submarine chaser makes a rush at a German U-boat, it must not only cut through the outer but must reach the inner hull with sufficient force to open it to the sea or start leakage along the seams. Moreover, shells which strike the outer hull or the conning tower may burst without any of the fragments having sufficient energy to penetrate the inner hull. These facts must be borne in mind in estimating whether a submarine which has been struck by a shell has actually been sent to the bottom.

The operating room of a German submarine

A. The captain at the periscope.—B. The man who controls the forward diving rudders.—C. Operator of switch-board controlling motors.—D. Wheelman controlling vertical rudder.—E. Periscope.—F. Steel tube which houses periscope.—G. Air manifolds, trimming lines, blows and vents.—H. Gage to show depth of submersion.—K. Transmission shafting, forward diving rudders.—L. Transmission shaft and knuckle of aft diving rudders.—M. Indicator giving positions of diving rudders.—N. Engine telegraph dial.—O. Indicators for aft diving rudders.—P. Speaking tube to conning tower for wheelman.—Q. Water-tight door leading to engineeroom.—R. Speaking tube from conning tower to wheelman.—S. Valve to cut off speaking tube in case conning tower is flooded.—T. One of three cylinders of the potash cartridge which purifies the air in this compartment.—U. Shaft transmission to vertical rudder.—V. Trimming ballast-tank manifolds.—W. Wheel controlling vertical rudder.—X. Cable connection between master gyro compass and "telltale."—Y. Gyroscopic master compass.—Y¹. Gyroscope "telltale" repeater.—Z. Wheel controlling forward Kingston valves.—Z¹. Wheel operating aft group of Kingstons.

Speed and Radius of Action

The smaller U-boats which the Germans possessed in 1914 had a speed of about fourteen knots on the surface and 7 knots submerged. The later boats of the type which visited Newport last year are of about eight hundred tons displacement, with 16 knots surface speed and 9 to 10 knots submerged speed. Because of the large amount of fuel oil which can be carried in the outer hull the U-boat has a wide radius of action. According to a description published by a German officer in a Berlin paper, the U-47, an 800-ton boat, has a radius of 5,000 miles at eight knots speed, and there is reason to believe that the smaller boats at the same speed of eight knots and with an extra supply of fuel, are able to cover from three thousand to thirty-three hundred miles.

Method of Operation

Because of its considerable freeboard of from three to four feet and its general ship form the U-boat is well adapted to surface steaming, and at the surface it is navigated

(*Concluded on page 583*)

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The U-boat which did the sinking. Note the long 4-inch gun

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Final plunge of a torpedoed ship, with the last of the crew sliding down the lifeboat falls and dropping into the sea

A Victim of U-Boat Pirates

IT is not often that the camera, ubiquitous though it may be, catches such a dramatic incident as that shown in this illustration of the last plunge of the victim of a German U-boat. The photograph was taken from one of the boats which had managed to get safely away from the sinking ship. To the right, is shown another of the boats, and the last of the crew are seen sliding down the life-boat falls to drop into the sea and be picked up later by the boats. Two men will be noticed at the top of the picture coming down the ropes, and to the left is the splash of a man who has struck the water. Our other view shows one of the later German submarines which are creating such havoc among shipping. It will be noticed that the deck structure and conning tower are similar to those on the merchantship "Deutschland." Particular interest attaches to the gun; for this photograph shows that they are carrying, in the open, pieces of at least 4-inch caliber and not less, surely, than 35 to 40 calibers in length. This gun, therefore, must have a fairly high velocity; which facts will account for the considerable ranges at which the U-boats have been able to land successfully upon fleeing merchantmen.

Strategic Moves of the War—May 31st, 1917

By Our Military Expert

As the spring campaigns open, it becomes more and more evident that the Central Allies are everywhere on the defensive. In 1914 came the grand strokes against France and Russia; in 1915 a limited offensive against France and the heavy drives against Russia and Serbia; in 1916 the tremendous drive at Verdun and the over-running of Rumania. But this year it is all changed. The English and Russians are driving back the Turks in Mesopotamia; the British against the Turks are doing the same in Palestine. General Sarrail has begun his offensive in Macedonia, the English and French have prevented a drive against Italy by the progress made on the Arras, Rheims and Champagne fronts, and now Italy has come to the fore by her remarkable successes on the Isonzo lines and on the Carso plateau; these have been rendered possible by the Allied victories in France, which undoubtedly forestalled strong attempts of the Central Allies against Northern Italy.

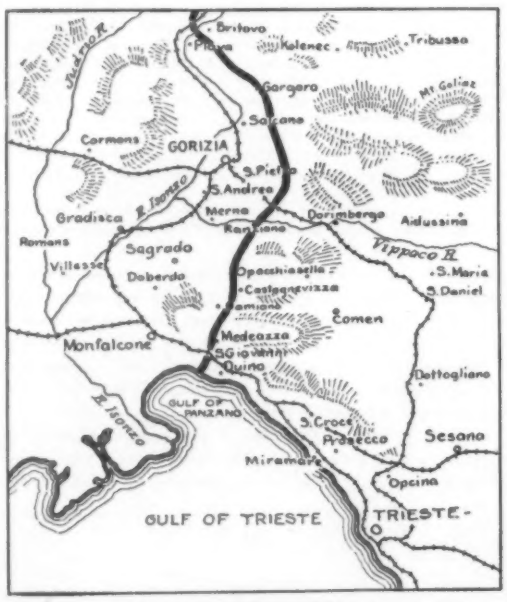
After several days fighting on the Isonzo lines, where the Austrians were led to believe that the main attacks would be made on the northern end between Tolmino and Gorizia, the able chief of the Italian Staff suddenly switched his main attack to the south of the last mentioned town and broke ten miles of trenches on the Carso plateau, extending his gains to the sea a little to the west of Duino. This brings the Italian advance to within ten miles of Trieste, the strategic objective of the entire movement, Austria's principal seaport, and the center of "Italia Irredenta." The strategy shown by the success north of Duino is quite significant and in keeping with the other operations in this remarkable campaign in a most difficult field. Duino is on the Adriatic seashore just where the southern extremity of the Carso almost projects into the sea. There is a narrow strip of shore, as shown by the map, which the Italians are trying to cross, thus coming out on a broad lowland road that continues for some miles before it reaches the cliffs running down to Trieste. The town of Duino is guarded on the north by a high mountain that has been strongly fortified by the Austrians; this mountain serves also to guard the Austrian left flank. The object of the Italian move is undoubtedly to turn this mountain by working around to the south of it in the direction of Sistiana and directly on the road to Trieste. Since Italy declared war in 1915, her strategy has been principally directed toward the capture of this city; her sealing up of the valleys of northern Italy against the advancing Austrians from the north and her careful preparations around Gorizia and on the Isonzo lines have been only the means to the desired end—driving the Austrians from Trieste and from the control of the Adriatic. Much criticism of the apparently small results heretofore obtained by the Italians has been thrown at them and at their leaders; but it should be remembered that from Lake Garda and the Adige on the north, around the Dolomites, the Carnic and Julian Alps to the Isonzo and the sea, Austria has controlled all the heights and Italy has thus had to fight, everywhere, up hill. On the other fields in this war the Allies have had to fight soldiers in the open; on the Italian front it has been a question of overcoming not only the adversary, but mountains, valleys, rocks and rushing streams. It is only now that the observer at a distance has realized what has been done by the Italian armies. Heavy guns and supplies have been transported up hills and mountain steeps that only expert mountain climbers have heretofore attempted. Bridges and cable railways have been swung over gulches and from one mountain top to another. Trenches and fortifications have been built and even mountain tops have been blasted away—all in the face of an enemy fighting desperately in resistance. It is only when this war is over and careful studies of the various fields of operations have been made that true credit will be given Italy for the work done by her army in its campaigns in this war.

But Trieste is as yet far from being taken; the intervening ten miles is over a most difficult country and one thoroughly defended. It is a continuation of the lava formations of the Carso, cut up with valleys and heights and with but few if any direct lines of approach. As suggested in the last review, the coast region offers the more advantages for an advance, and the Italian commanders are taking full advantage of it. The thrust forward of the Italian forces on the Carso plateau threatens, however, the railroads running into Trieste; and, if this movement can be extended, the railroads will be cut and Trieste isolated. Should Trieste fall, the control of the Adriatic would go with it.

At Pola, upon the southern extremity of the Istrian peninsula, the Austrians have their main naval base; but the railroad lines serving it go through or near Trieste on the north and can be easily reached or destroyed by artillery fire. Fiume, across the peninsula to the southeast of Trieste, is the principal submarine base of the Austrian navy and will be seriously menaced once Trieste is in possession of the Italians. While the fall of Trieste would not have the same influence on the war as the capture of Douai in France, yet its effects would be tremendous throughout Italy and Austria.

The Austrians have no other naval bases until Cattaro is reached on the lower part of the Adriatic; this is also the seaport of Cettinje, capital of Montenegro, but it is without rail communication with the rest of Austria. If Trieste, Pola and Fiume are taken, with the British, French and Italian fleets in the Adriatic waters, the Austrian fleet and the Austrian and German submarines in the Mediterranean would undoubtedly be in a bad plight. The situation as it exists for the Austrians on the Isonzo front would apparently lead to the belief that, at the very least, their lines have geen greatly strengthened by troops taken from the Russian front before the Italian advance began. As the Italians have pushed ahead despite the strong resistance of the Austrians, taking in less than two weeks more than 24,000 prisoners and much material, it must be concluded that the Austrian resources are gradually coming to an end. The results have certainly shown how prepared and how efficient the Italian army is under its present leaders.

On the French and British fronts both armies have driven forward into positions where new advances may begin; but present indications are that the recent operations are closed. A preparatory lull will intervene for the concentration of the forces and material and then the fighting on a major scale for the second phase of the great offensive will ensue. Some plans appear to be



The advance toward Trieste

in process for a further German retreat as it is learned from official sources that the civilian population of certain districts in Belgium is being driven out.

On the Arras front the position of the Germans is certainly precarious under present conditions, though no one knows what reserves of men and guns the Germans may have brought up behind their lines. On the Scarpe River the British have opened a gap of nearly twelve miles in length with no German fortifications in front of it except what are known as the Drocourt-Quéant lines—the last defense system before Douai. From Drocourt this line or zone runs northwest to join the old lines near Lens. But the British have worked to the southeast at Rouvroy on the north and Quéant on the south; so that the positions at each end, Drocourt and Quéant, are practically flanked. If the British can take the few remaining parts of Hindenburg's lines, they will have the only important defenses in front of the Douai-Cambrai position. Just at the present writing there has been a cessation of fighting since the capture of Bullecourt. It would seem that this for the British is probably due to the need of consolidating their positions, getting up their heavy guns with the necessary ammunition and giving a much needed rest to those who have kept up fighting for so long a time. It may possibly be due also to the continued counter-attacks of the Germans who, although inflicting heavy losses on their adversaries, have suffered much more serious losses themselves. If Russia were only now in a position to take advantage of conditions on the Western front, the German losses would be a serious matter for them.

While the French have not taken over as much of the German defense as the British have, still they are now up against the main German fortifications west and south of Laon and also in the same manner on the Champagne front. They are also pushing forward to the northwest and east of Rheims and are making, for the Germans, very dangerous progress toward the gateway of a turning movement on Laon. As with the British to the north, the advance is a nibble day by day, that in the end will clear the Rheims salient and bring the French poilus to the outskirts of Laon, coming from the east. The natural and artificial difficulties of an advance from the Craonne plateau across the valley of the Aillette River or farther west along the roads leading from Soissons to Laon are very great and would lead to the loss of many men and much material before any serious progress could be made on that side. To the east of Rheims there has been heavy fighting around Nauroy, Moronvillers, and on the heights in front of and to the east of Auberive. The battle has been principally artillery fire on both sides with the superiority in general on the side of the French. Everything indicates a determined offensive at an early date on the part of the French troops.

Nothing of any great interest appears to have occurred on any of the other fronts except sporadic conflicts brought on by minor advances on one side or the other. Due to the unofficial truce that appears to have been declared on the Russian front, many Austrian troops have now been brought to oppose an advance on the Isonzo front; the Russian problem is a serious menace to the Italian military operations for, if Russia declares a separate peace, all the Austrian military strength will be brought against Italy. A few days or weeks will suffice to tell the tale whether Russia can be relied upon to be of any assistance to the Entente Alliance or whether, as she is at present, she will prove a drag and hindrance to a vigorous prosecution of the war. If a strong Russian attack could be made now it would no doubt be the beginning of the end for Germany. One thing is certain: the Eastern front is now very weak in men and guns and Germany cannot strengthen it without withdrawals from the Western front—something now impossible to do. The Rumanian army has been reorganized and is also a power that would have to be reckoned with in an advance or in an attack along the Moldavian lines. Unlike Russia, the Rumanians have had nothing to contend with as regards the discipline and commands in the army.

There can be no doubt that German influence is behind most of the internal troubles of Russia and will continue to be so until radical steps are taken to uproot it. This influence has extended for years throughout the world, eastern Europe especially, but few in our own country have recognized it. The publication in Washington recently of the plans of German conquest—otherwise known as the "Mittel Europa" designs—is a delayed recognition of what has been known for a long time by those well informed of the true aims of German policy. The map published with the articles referred to shows that in a way those designs are already accomplished by the conquests made since the war began. That plan is and has been to dominate all Central Europe, to make of Austria a subject state, to rule over the Slavs of that country and in the Balkans, to control Servia, Rumania, Greece and Bulgaria, to be master in Constantinople, and to make of Asia Minor, Palestine and Mesopotamia German colonies. So far as Europe is concerned, the gains in France and Belgium could be given up; and yet her designs, as far as the other countries are concerned, would be already carried out by her conquests. So that any peace under present conditions that allowed Germany to hold her conquests in Eastern Europe would be only a stop-gap for other wars soon to come in the future.

It is most encouraging that our Government has at last awakened to the dangers of a too early peace; for no peace could be permanent that would leave present German conquests in German hands or subject to German influence. And it is hardly probable that any peace would be considered by the Entente Allies that would leave without full indemnity Belgium and France, that have been so barbarously treated and ruined by the Teutons, or that would leave Alsace-Lorraine and Italia Irredenta to German rule. For the Allies have certain purposes in this war which must be accomplished before the war can end. Alsace-Lorraine, taken away in 1870, must be returned. Italy is determined to liberate the Italians in the Trentino and along the eastern coast of the Mediterranean. Great Britain's colonies have taken the German possessions in Africa and in the Pacific Ocean and these colonies are determined that there shall be no future danger from them. Australia would of course never return to the rule of the Kaiser the islands taken by her. German West Africa was for a long time the hot bed of German propagandism; having been conquered by Boers and British colonists, it can be safely assumed the latter will never consent to any return to German rule or influence of the lands now held by them.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Department of Aeronautics

To the Editor of the SCIENTIFIC AMERICAN:

Congratulations on Lieutenant Faulkner's articles on Air Matters. There cannot be too much of this class of valuable material put before the public by big reputable publications like the SCIENTIFIC AMERICAN right now.

As you doubtless are aware there are identical bills now before Congress for the creation of a separate Department of Aeronautics. These bills are modeled on the bills which created the Department of Commerce and Labor, and later the Department of Labor. Both were introduced by members of The National Aerial Coast Patrol Commission, Senator Sheppard of Texas, in the Senate, Congressman Hulbert of New York, in the House. It is vital that these bills be enacted into law as speedily as possible.

There was a brief interchange of ideas on the floor of the Senate on this subject and more than one prominent and influential senator stated in so many words that such a department would ultimately be necessary. Our lawmakers, however, have not yet grasped the fact that the need is *immediate* and that is what it is desirable to impress upon them. Such a department should be in existence this minute so that the work of giving the United States a great air fleet, which our importance and safety demand, could already be hustling along.

The SCIENTIFIC AMERICAN and its readers can help the matter along pronouncedly by writing personal letters of approval of these bills to Senator Morris Sheppard—to Congressman Murray Hulbert—to Chairman Dent of the House Military Committee, to which the Hulbert bill was referred—to Chairman Chamberlain of the Senate Military Committee, to which the Sheppard bill was referred—and to Senators and Congressmen generally.

ROBERT E. PEARY.
National Aerial Coast Patrol Commission.

Nets for Protection Against Torpedo Attack

To the Editor of the SCIENTIFIC AMERICAN:

It is very perplexing to the lay mind why, after thirty months of war, mechanical means have not been devised for warding off torpedoes and diverting them from their course. Sometimes one inclines to the belief that the Entente Governments have not wanted such devices brought out, for the reason that they have desired to see Germany embroil the United States in the war on the side of the Entente. But how about America, and American ship owners and Marine Insurance Companies?

The following simple and unprofessional device for the protection of Merchant Ships may be easily dismissed by you, but as it seems practical to me I will risk presenting it, and hope it may at least start something.

The 1916 Edition of the New International Encyclopedia says Torpedo Nets are not considered of much practical value to a ship in motion, but does not state very clearly why. If it is because the motion through the water has a tendency to telescope the nets and wash them to the surface, it might be possible to substitute a rigid steel frame, enclosing a network of ¼-to ½-inch wires or cables, arranged vertically and horizontally; the vertical strands being somewhat heavier than the horizontal and being spaced about every 5 feet, and the horizontal strands being spaced about every 6 or 12 inches. The frames might be divided into 25 to 50 foot sections, with proper diagonal stays and braces, the sections being interlocked, and suspended from a large wooden beam floating on the surface at any desired distance from the side of the ship. Rods would be provided, extending from the sides of the ship somewhat above the water line to the floating wooden beams, for the purpose of holding the latter in position laterally, the rods being pivoted near the beams and provided with a short sliding joint, to take care of the ship's rolling. Also the beams being longer than the ship, rods might be extended from right beam to left beam, passing in front and in rear of the ship. Other rods would extend from the bottom of the frame to the keel of the ship, or beneath the keel from frame to frame, for the purpose of holding the bottoms of the frames laterally in position; while cables extending from the prow of the boat to a point somewhat forward of the middle of the supporting beams, would furnish means of propulsion.

Now suppose a torpedo traveling at right angles to the path of the ship strikes the net, the ship traveling east and the torpedo north. The latter having of course no eastward momentum its forward end will be jerked around to the east by contact with the moving horizontal wires, or by engagement with the first passing vertical wire of the net. If the impact explodes the torpedo the net will be destroyed but the ship saved. If it does not explode the torpedo the latter will start traveling eastward with the ship, but outside of the net, where it can do no harm, and the ship can either capture it or veer to the northward and leave it to exhaust itself.

If experience developes the fact that in a large percentage of cases the impact of the torpedo against the rigid net will explode it, leaving an opening for a second torpedo to pass through to the ship, it might be possible for a ship to carry the two nets on each side, with proper spacing between, since each is supposed to float, and would therefore be no burden on the ship except in the matter of propulsion. The outer beams and frames could be attached to the inner in the same manner that the latter are attached to the ship.

Resistance could be reduced to a minimum by sharpening the forward edges of all vertical parts of the frames. If the nets proposed would be too heavy for the wooden beams to float they could be reduced to a minimum, and if necessary, other forms of supports with greater buoyancy substituted. Cost would hardly be an item as it need not be great, and to offset it, ocean freight rates are very high at present, and a sunken boat carries no more freight. Also the nets might be used for many trips, and war risk insurance might be reduced.

Means could be provided for quickly detaching the nets at the harbor entrance, or drawing them in against the sides of the ship.

F. S. EATON.
Tulsa, Okla.

A Question of Fertilizer

To the Editor of the SCIENTIFIC AMERICAN:

It is with a great deal of irritation that I have watched in public press and periodicals for some mention of fertilizers for our immediate needs. Up to this time all the talk seems to have been about plowing up and putting into bearing as large an acreage as possible. That a supply of seed is available this season there is no doubt, but there is one other thing almost as necessary as seed, fertilizer. Many times it is far more necessary. Where shall we turn for the millions of tons of extra fertilizer that are required this year to put these millions of extra acres to bearing proportionately? The answer is: they are unobtainable, and the crops will be a very sore disappointment.

We should pause a moment and consider that Greater New York consumes at least one-twentieth of the food that is eaten in the United States. This great product in its various forms of human and animal excreta and other waste matter is the very richest element of the lands from which it came. Naturally, it being a pure waste, having served its purpose, it is passed along as such, and conducted far out into the sea where it is out of our way forever. Alas, this is too true, it is gone forever from us, from the land, from our future, and is safe in the bottom of the sea.

New York City is not alone in her crime against herself, her future, and the welfare of civilization. We hold up our hands in horror at the thought of burning off great mountains of timber, then burning up the vegetable mold upon which trees might ever hope to find a footing in the years to come, yet this is the very thing that great and small cities, villages, communities and all are guilty of doing. We eat, and our domestic animals eat, in the form of grains, vegetables, and meats, all the richer portion of the products of the soil, and then with as little regard for it and the future, we throw it all away, so far away that it is beyond any hope of recall. If it is not dumped far out to sea it is destroyed as effectually by various means.

I do not believe I err very greatly in saying that if the waste human product could be sewered, not into the ocean, but into vast reduction plants where the soaps, fats, oils, etc., could first be reclaimed, then the other constituents chemically treated, and reduced to such elements that they could be returned to the soil as fertilizers, that the income from such reduction plants would equal or exceed the profits derived from the petroleum interests of the United States.

Fertilizers are unobtainable this year, and yet we are dumping into the seas and the rivers leading thereto millions of tons of them, merely to get them temporarily out of the way. Think of it! Inconsistent? We are a great nation of wasters, that we all know, but we are beginning to learn. That we can learn much from the Chinese in agriculture we have yet hardly come to believe, yet we see what the great agricultural empire of China has done in supporting a population of four hundred millions of people, and it is a fair guess that their soil will average today very much higher in all those elements which constitute richness than our own virgin country. The answer is that nothing is wasted, everything is returned to the soil. We may well imitate the Chinese, but we may also greatly improve on them. Their methods of salvage are primitive, but we may not only imitate them but we make make an even greater salvage by more scientific means. Those sandy flat lands of New Jersey are just the lands upon which to construct great reduction plants. Sewage would have to be pumped, but that is not a superhuman feat, and once delivered it is, or will soon be, within the province of our industrial and agricultural chemists to separate, segregate, and so treat this waste matter as to reclaim to industry and to agriculture such profitable returns that the income will rival that of the petroleum products.

Granville, N. Y. FAY MCFADDEN.

The Beet as a Substitute for Cotton

To the Editor of the SCIENTIFIC AMERICAN:

Throughout the whole course of the war raging in Europe, there have been all kinds of surmises as to how Germany got the cotton to use in the manufacture of nitrocellulose, which as most people know is the principal ingredient of smokeless powder.

It has been proved by past experiments that wood fibers make but poor substitutes for cotton fibers in this industry. It is also known that while starch can be used and has been used in the manufacture of shotgun smokeless powders, still these powders are of a type denoted by the term "bulk powders" and up to the present time there seems to be no way of utilizing this in place of the "dense" powders of which all military powders are a class.

There is one substitute for cotton that can be used to great advantage in the smokeless powder industry, and it is also a waste product from another great industry, of which, even in this country, thousands of tons go to waste every year, and in Germany this waste product must reach an unthought of amount. This is the waste product, or pulp, from the sugar factories that utilize the sugar beet to make commercial sugar. The fibrous part of the beet combined with other impurities constitute this waste product and this is nearly all pure cellulose.

As all of the sugar used in Germany comes from the sugar beet there must be millions of tons of this product wasted every year, that is if one is to judge from the immense piles of refuse that accumulated around the sugar factories in Colorado, Wyoming and western Nebraska.

In Germany, where attempts have been made to utilize all waste products, it does not seem possible that such an accumulation of refuse would not attract the attention of some chemist who would make the attempt to use it in the manufacture of a substance of which Germany must use millions of pounds every day, and upon the possession of which her success in waging this war depends, *i. e.*, nitrocellulose products or smokeless powder.

That this substance does make a good quality of nitrocellulose, the writer knows from past experience. Branching out from the analysis of the various kinds of smokeless powders, which as a gun crank and experimenter, he was using nearly every day, it was only a short step to the attempt to make the powder from the raw materials. The mechanical processes were of such a nature as almost to forbid the making of smokeless powder from cotton; but as the beet pulp was already in as fine a condition as needed to make powder, the mechanical processes of pulping the nitrocellulose could be omitted, and this was done. The rest of the processes could be carried on in home-made apparatus and so several pounds of a good quality of smokeless powder were accumulated. An attempt to make a larger quantity and better quality resulted in an explosion that nearly wrecked the premises and brought on a civil war, so that branch of the gun crank's testing had to be laid one side, but what the writer has done with crude home-made apparatus, it is very certain that Germany will be able to do with her huge plants and the experience of chemists brought up in the industries of powder making.

Therefore, while the writer does not know for a positive fact that Germany is carrying on the manufacture of smokeless powder from the pulp of the sugar beet, still there is no doubt but that it is done, for cotton is a scarce article there these days and here is an article going to waste, a grade of cellulose far better than wood pulp ready at hand for use in this great industry and needing far less work to covert it into the finished article.

"BILL."

A Correction

WE deeply regret a criticism appearing in last week's issue of the SCIENTIFIC AMERICAN upon the Royal Aircraft Factory of England. This aspersion which appears in a paragraph in the body of a long article on "Britain's Bid for the Control of the Air" was not noticed by the Editor until the edition was entirely printed and placed in the Post Office. It was then too late to eliminate the offending sentence. The SCIENTIFIC AMERICAN exercises every precaution against the use of abusive or personal attacks, and wishes to withdraw voluntarily and at the earliest possible moment the insinuation which was the opinion not of the Editor, but of the contributor, who was himself not an American but a British subject.

There is some justification in the attitude of resentment felt by the aviators themselves towards the machines of the Royal Factory, which earned for these aeroplanes the title of "suicide shells." The shortcoming of these machines was discussed in Parliament, but it is more charitable to ascribe their failure to errors of design and faults of construction than to any ulterior motives.

The Electric Arc In Wireless Telegraphy

How the Once Erratic Generator Has Been Developed Into a Most Successful Radio Transmitter

By Eugene Murphy

AFTER the mystery has been extracted from wireless telegraphy, this ultra-modern method of signalling resolves itself into a problem of generating electromagnetic or Hertzian waves, imparting these to the ether or space, and then gathering and detecting these same waves at some distant point. Wireless telegraphy is nothing more than that, as wonderful as it seems—and is.

The methods of generating wireless waves may roughly be divided into two classes: first, those which generate waves or oscillations which are more or less rapidly damped out, to be followed by a new group of oscillations; second, those in which the oscillations are undamped, or continuous and of constant amplitude. The latter-class generators have of late been found to be most efficient in long-distance transmission; indeed, their introduction in a highly-developed form has been followed by the covering of distances heretofore unapproached by the usual types of transmitters. The first class includes those generators which produce waves by means of some form of spark discharge, while the second class includes those generators of the high-frequency alternator and the arc types.

Night view of one of the layers of the "dummy" aerial, showing the corona or brush discharge from each strand

The undamped radio transmitter was invented by Valdemar Poulsen of Denmark, and his patent rights in the United States were acquired by an American wireless telegraph concern of San Francisco, Cal., about six years ago. Since that time the company has developed a system from the original arc of 5 kilowatt rating received from the Danish inventor to the powerful units of 500 kilowatt capacity now constructed. That the task was not a simple one is evident from the remarks of Dr. Goldschmidt—a prominent figure in wireless telegraph history—as late as 1915:

"The arc as a generator is a device that some time ago seemed to be practically hopeless. No one supposed that so erratic and irregular a device as an arc could be used to produce a steady flow of very high frequency alternating current. It is, therefore, a scientific *tour de force* that we have been able so to build and control arcs by circuits connected to them that they have now become satisfactory and reliable generators of considerable amounts of sustained energy. Of course, in a radio station, 50 kilowatts is a large amount of energy."

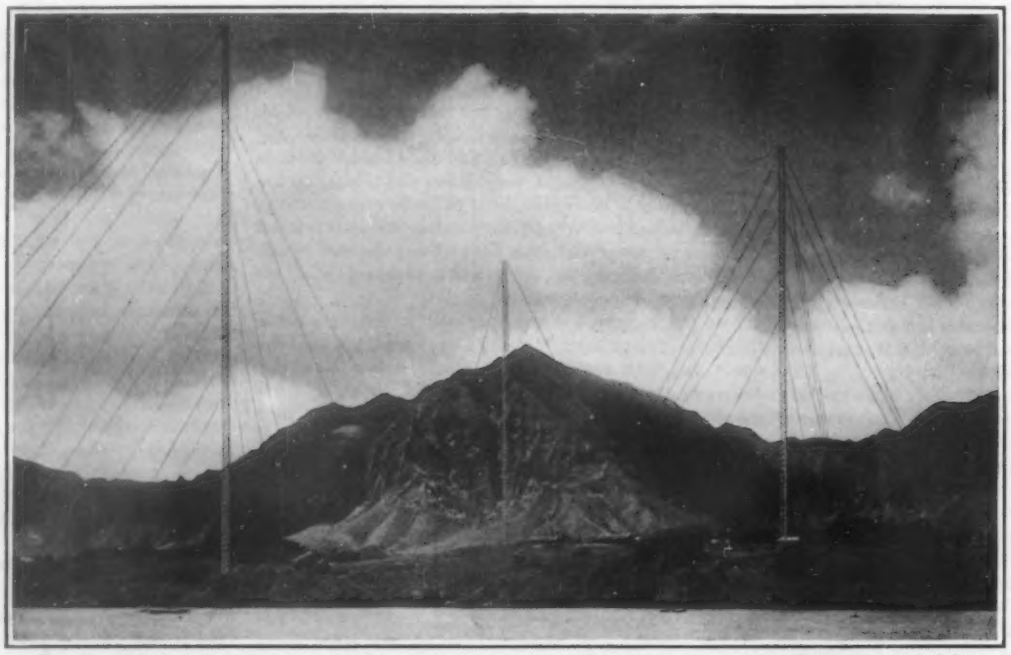
The American Poulsen arc generator of undamped oscillations consists of a direct-current arc maintained in an atmosphere of hydrogen within a closed, water-cooled chamber. Across the arc is placed a strong transverse magnetic field. The electrodes are of copper (for the positive) and carbon (for the negative), this combination being the most suitable for producing the flow of electrons necessary. The carbon, or cathode, is revolved at a low speed in order to insure steadiness of the arc, while in the higher powered arcs the copper anode is water-cooled.

The function of the magnetic field is that of a magnetic blow-out, which periodically extinguishes the arc; and the hydrogen, having the highest known coefficient of diffusion, or molecular velocity, permits the gap to be rapidly deionized and thus increases the voltage at which re-ignition of the arc takes place. The combination of the hydrogen atmosphere and the magnetic field across the arc is the foundation of Poulsen's invention; and this generator, placed in an oscillating circuit such as is formed by an antenna connected to the ground (or its equivalent), produces in the circuit alternating currents, or oscillations, of constant amplitude and whose frequency depends on the inductance and capacity of the circuit. The antenna circuit then radiates continuous electromagnetic waves of a length corresponding to this frequency.

At the present time the American Poulsen company maintains a regular commercial telegraph business on the Pacific coast from Seattle and Tacoma, in the north, to San Diego and Phoenix, in the south, and to Honolulu. This is believed to be the only radio telegraph system actually competing with land-wire telegraph lines.

It is difficult to say whether the requirements of commercial service were the cause of the great development of the arc-generator, or whether the improvement of the latter was the means of bringing this service to its present state of efficiency. At any rate, the high state of perfection reached by the arc generator is contemporaneous with a highly-efficient commercial service.

When the American wireless organization started commercial service the units were of five kilowatt input, direct current. This necessitated much relaying of messages in order to cover the distances required. With the establishment of an experimental laboratory and factory, however, marked improvements soon followed, and with the always increasing knowledge of the principles of arc design it became possible to use higher powers. Radio sets of 12, 15, 20 and 30 kilowatt rating were successfully developed, and with them came the elimination of relay stations, the improvement of the telegraph service, and the inauguration of the San Francisco-Honolulu wireless service. Each of these stations has towers of 440 and 600 feet in height—probably the tallest wooden towers in the world. In one of the accompanying illustration may be seen the Honolulu station, with its lattice-type wooden towers. By way of indicating the efficiency of the present-day arc generator, it may be noted that this trans-Pacific service is maintained at all times by generators of only 60-kilowatt rating, and that full power is seldom used. In another illustration appears the 30-kilowatt arc generator employed for service between San Francisco and Portland, Ore., while in still another illustration appears the 60-kilowatt arc used in the Honolulu-San Francisco service.



The Honolulu wireless station, showing the lattice masts which, measuring 440 and 600 feet in height, are probably the tallest wooden masts in the world

Recent improvement in receiving apparatus and the fine "tuning" possible with undamped wave transmission have made possible the "duplexing" of the arc system. All messages are handled but once, and this direct from the main offices in the heart of the various cities served. At San Francisco, for instance, there are two transmitting stations, one working with Honolulu and Portland, Ore., simultaneously, and one working with Los Angeles and the South. A message received is immediately and directly sent to its destination by an operator in the city office, who, by means of an ordinary Morse key, works a relay transmitting key in the arc circuit of the outlying transmitting station. The arc is burning continuously, at all times, in order to ensure no loss of time in transmission, and the various city offices have small receiving antennae suspended from the buildings which they occupy, so that the sending of messages in no way interferes with the simultaneous reception of messages from the different points. Messages which thus arrive directly at the main office, are ready for immediate delivery. A difference of 3 per cent in the wave length is sufficient to avoid interference between stations.

In another illustration appears a typical 5 kilowatt arc as installed on shipboard in many commercial vessels on the Pacific The switchboard which accompanies this generator mounts at the top a switch which gives instantaneous change of wave length. On the board is also mounted the "chopper"—a motor-driven commutator for breaking up the continuous waves into audible wave-trains, receivable by ordinary "spark" receivers or detectors

The records for long-distance communication by means of the arc sets carried by merchant ships plying to Australia, have previously been noted in the columns of this journal.

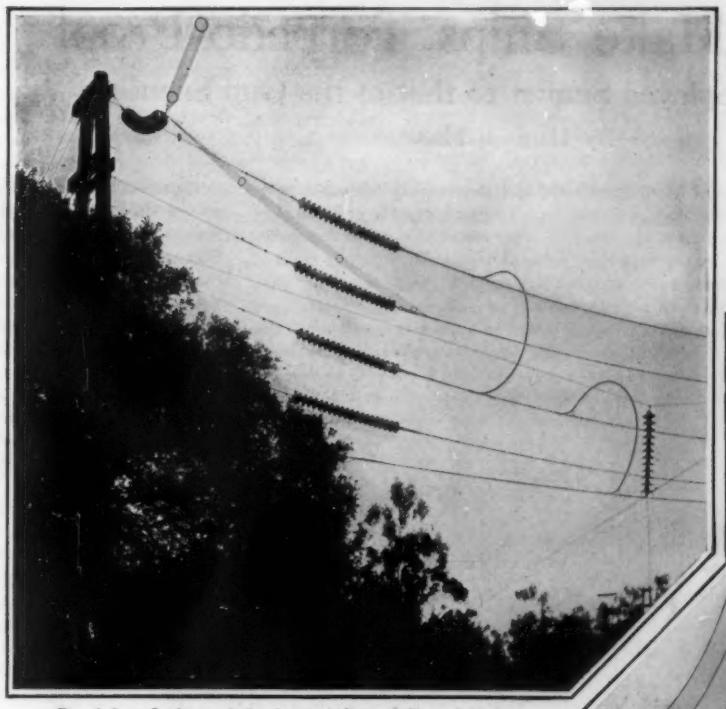
The United States Navy uses arc sets of varying power on its vessels. The range of these sets must be very great, and it is learned from press reports that two war ships have been in direct communication with each other from the Atlantic to the Pacific—across the continent.

But it is a far cry from these radio sets to the great land stations now being installed by the United States Navy. The apparatus at Darien in the Canal Zone and at Arlington, Va., at the time of installation represented the solving of the problem of high-powered arcs; but when the radio telegraph engineers were called upon to supply generators of 200 kilowatt imput with 150 amperes in the antenna for the San Diego station, and of 350 kilowatt input and 200 amperes in the antenna for the Pearl Harbor and Cavite stations, they were faced with a problem requiring an enormous amount of investigation and experimentation along lines never before attempted.

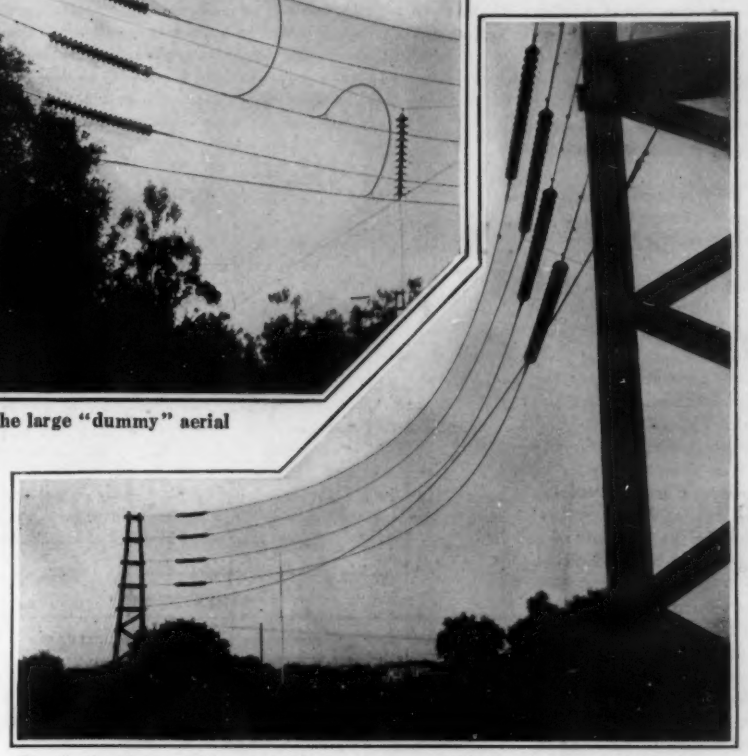
In order to test the large arc converters the engineers of the company designed a special antenna which, while serving to simulate actual operating conditions, would interfere but little with nearby commercial stations. This antenna, which is illustrated in the remaining views, is of unique design. It affords capacities up to 0.031 microfarad, and because of its construction it has a low effective height, causing a minimum of interference. Five parallel layers of wires spaced 5 feet apart vertically, constitute the antenna. The wires in each layer are 2 feet apart horizontally, and there is a 10-foot clearance

between the ground and the lowest point in the bottom layer. The bottom layer, which is grounded, is 136.5 feet wide with a maximum length of 262.5 feet. The other layers, insulated from the ground, are 20 feet shorter and 41 feet narrower. The insulated layers have 51 wires each and the grounded layer 66 wires.

Beneath the fifth layer there are two single wires which are normally not connected and have a separate lead running into the laboratory. These have a capacity of 0.002 microfarad. By various combinations of these wires with different layers of the antenna a considerable number of capacities are available, the maximum being obtained when layers Nos. 1, 3 and 5 are connected as the earth side of the system, and Nos 2 and 4 are connected with the two single wires as the high potential side. With this combination the capacity is 0.031 microfarad The jumpers, which may be seen in one of the illustrations, are used for connecting the various layers and consist of 1½-inch copper tube provided with suitable clamps and fittings, so that shifting to different capacities is an easy matter. The capacities most commonly used are 0 006, 0.012, 0.017 and 0.024 microfarad Many others, however, are available At night the corona or brush discharge caused by loading the antenna with the high-frequency current from a large arc set may be plainly seen, each strand being enveloped in a purplish light The antenna, it is said, has proved invaluable for testing purposes.



Partial end-view of the large "dummy" aerial



For the testing of high-powered arc-generators this five-layer aerial has been constructed by a wireless apparatus builder

The power machinery for the largest arc sets now being constructed was made by a leading manufacturer of electrical apparatus. It consists in each case of a motor-generator set with automatic starting device and both local and remote control. Constructional details of these sets cannot be given at the present writing, but an idea of their size may be gained when it is realized that each of the arc units is approximately 9 feet in each dimension and weighs 65 tons. These large installations, together with several smaller ones now building, will undoubtedly give the United States a series of radio stations which will be absolutely unrivalled for power and range.

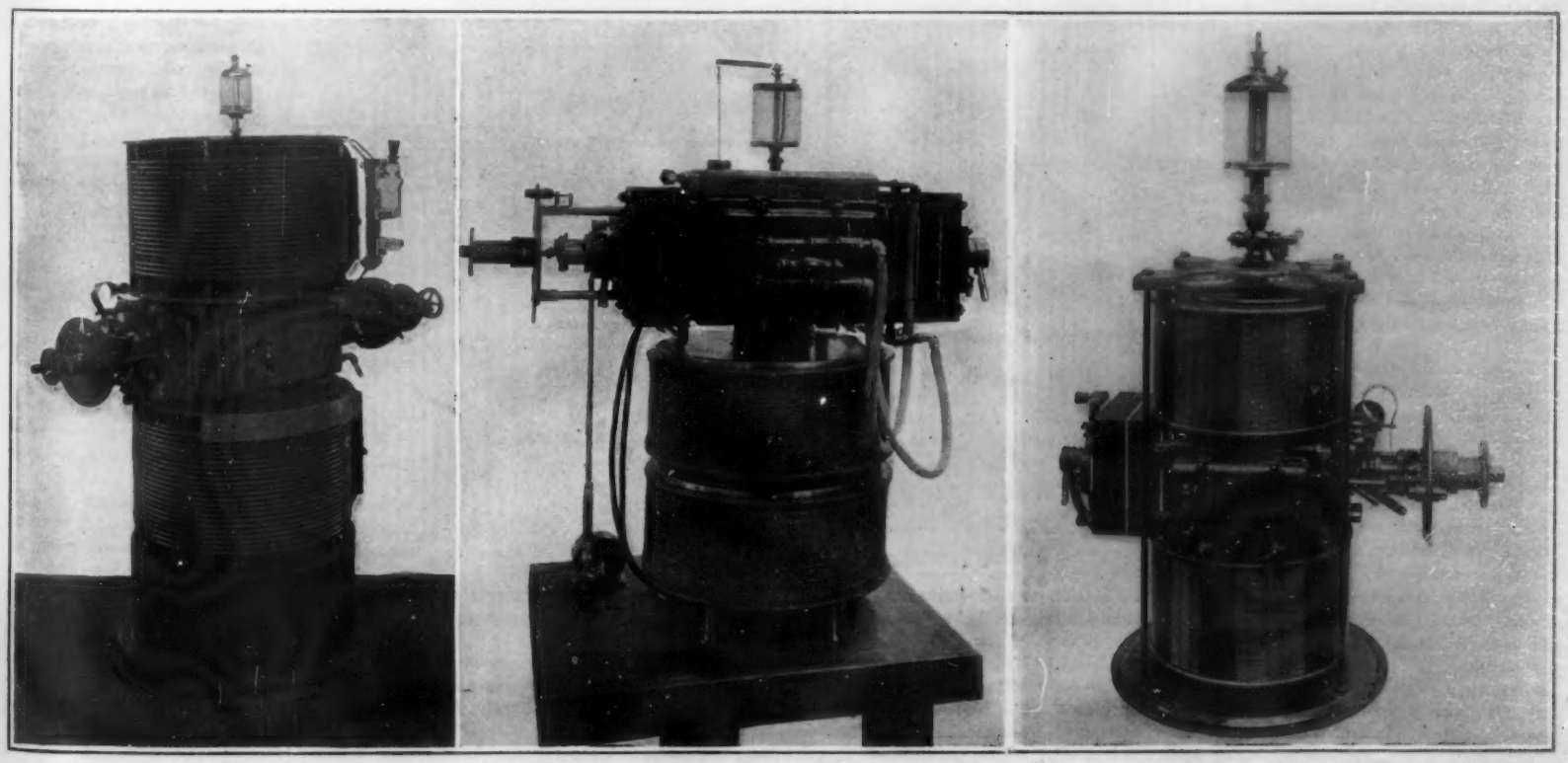
Direct communication, at all times, and under all conditions, will be maintained between our Capital, our provinces and our fleet by means of arc sets. Indeed, every American, at this time particularly, should be proud that our Navy has shown the courage and foresight to build this magnificent system of world-communication. Developed by American genius, it is a system which is not approached by that of any other nation.

The Current Supplement

STUDENTS of geology will be interested in the article on *The Periodic Submergence of Europe*, in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2162, for June 9, in which the notable views of Hébert are examined. *The Conservation of the World's Teeth* tells of a new occupation for crippled soldiers, and describes how a man with but one arm can successfully perform the ordinary but important dental work of cleaning the teeth. Two photographs illustrate the text. *A Vacuum Cleaner for Street Use* illustrates and describes machine that has recently been put into successful operation. *The Extraction of Benzol from Coal Gas* is a technical article of considerable present importance, and it is accompanied by an explanatory diagram. *Commercializing a Cuban Jungle* is an interesting account of how a big sugar plantation was carved out of a dense forest. *Oil Makes Millionaires* is a remarkable story of the wealth that has come to the oil operators in our southwestern country, largely as a result of freaks of nature, but also from the inflation of prices by the war. It is illustrated by a number of new photographs. *Shipyard Cranes* gives details of elaborate equipments installed in Rotterdam, and includes information of value to many of our new enterprises. *Insects that Deceive* gives many interesting instances of how nature protects its weaker members, and there is a large number of illustrations of curious insects from all parts of the world The paper on *The Organization of Thought* is concluded in this issue. *Reform in Food Distribution* is most timely, as it describes a system of collecting and distributing food products that will bring better returns to the producer, and more reasonable prices to the consumer, besides eliminating waste Other articles of interest in this issue include *The Pagan Tribes of the Philippines; The Carriage of Disease by Insects; The Photometry of Luminescent Substances; Measuring Starlight by Selenium; Ancient Distribution of the Labrador Eskimo; Finishing Concrete Road Surfaces; Human Measurements and Resistance Formulas; Recent Data Concerning Palm Oil; Dash-een Finds Favor; Burned Grain or Flour; Development of the Timber Industry of Russia*, and *The Menace of the Rodent.*

Infantile Paralysis

STATISTICS published by the Public Health Service show that, in the Infantile Paralysis epidemic of 1916, the cities having the highest case rate per 1,000 population were, in order, Newark, N. J. (3.478 per 1,000), New York, Trenton, N. J., and Syracuse, N. Y. The greatest number of cases, 9,023, occurred in New York City, and the deaths registered in that city were 2,448. Newark had 1,422 cases and 375 deaths; Philadelphia, 1,006 cases, and 307 deaths.



The 60-kilowatt arc generator used in the Honolulu-San Francisco radio service

The 30-kilowatt arc generator used in the radio telegraph service between San Francisco and Portland, Ore.

A 5-kilowatt arc generator which is typical of those installed on steamers plying the Pacific ocean

Three typical arc generators for use in long-distance land-station work and on shipboard

How to Make Ships Torpedo-Proof

Principle Employed Similar to that of the Gun Silencer

By Hudson Maxim

I HAVE decided to make this invention public for the following reasons:

It is necessary at this time to stimulate inquiry and invention with respect to ways and means for protecting freight-ships and troop-ships against torpedoes, and while I believe that my plan of torpedo-proofing ships will be very efficient, and that it is the best thing that has yet been suggested, still what I have done may possibly serve as a suggestion to lead some other inventor to do far better than I have done; and the facts that I have given in this article about the nature and action of the explosive blast, will help others in the investigation and understanding of this subject.

The Germans are not looking for improved means of protecting their ships, consequently the publication of this article will give neither aid nor comfort to the Germans.

When a gun provided with a Maxim Silencer is fired, the Silencer acts to dissipate and absorb the energy of the escaping gases, thereby lessening the intensity and suddenness of the shock upon the atmosphere.

I propose to employ a principle similar to that of the Silencer for dissipating the energy of the explosive blast of a torpedo against and into the hull of a ship. In addition to this, the gases of the explosive blast are made to take up, spray and mix with a sufficient quantity of water, instantly to reduce their temperature and volume about tenfold.

When a mass of high explosive, like the contents of a torpedo-warhead, is exploded against a ship's hull at the usual depth of say from nine to eighteen feet below the waterline, the mass of water surrounding the explosive serves to tamp it, that is to say, it serves as an anvil to resist the blast in all other directions except toward the interior of the ship; and as the ship's hull is the line of least resistance, the great mass of gases under high temperature and pressure passes into and through the hull of the ship with such destructive violence as to cause the immediate sinking of a large vessel of ordinary construction.

The German torpedo is supposed to carry about four hundred pounds of tri-nitro-toluene (T. N. T.). The density of this explosive is such that a cubic foot of it weighs about a hundred pounds, so that, roughly, the capacity of the warhead of a German torpedo is about four cubic feet.

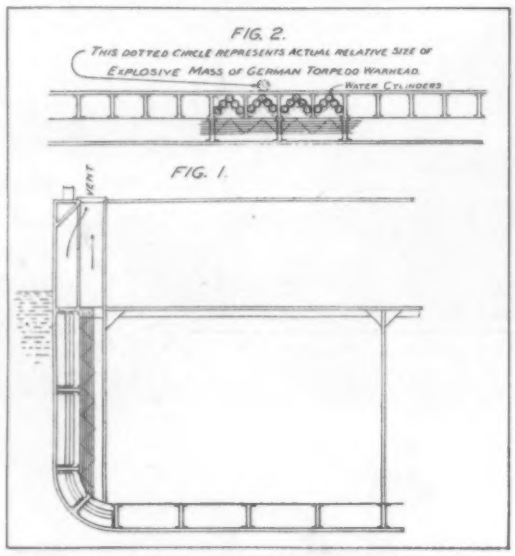
The speed of the detonative wave is about 20,000 feet per second, consequently this entire mass of explosive, armed with central detonator, is consumed in less than the twenty-thousandth part of a second, the action being practically instantaneous.

We have, therefore, at the instant of complete detonation a mass of incandescent gases occupying a space of about four cubic feet, and having a density more than one-and-a-half times that of water. Consequently, the pressure exerted upon the surrounding water and the ship's hull is enormous. We do not know more than approximately how high the pressure is, but it is probably in the neighborhood of half a million pounds to the square inch.

So quick is the action and so great the pressure that the water surrounding the ball of incandescent gases is compressed more than twenty-five per cent of its volume in the first foot of distance, before it has time to be displaced. This sets up a wave of compression or sound wave in the water, which moves outward in all directions, at the rate of nearly a mile per second. The speed of the wave is constant, but the length of it, that is to say, the distance between extreme density and extreme rarefaction, decreases inversely as the square of the distance.

This wave of compression, impinging upon the hull of a ship, breaks rivets and opens seams in all directions to a considerable distance from the seat of explosion.

At the instant following detonation the gases begin to expand in all directions, and they expand as much more rapidly on the line of least resistance as the resistance on that line is less than in other directions. Consequently, the highly resistant mass of water surrounding the ball of incandescent gases serves as a gun, while the gases themselves, serving both as propellant and projectile, are hurled on the line of least resistance through and into the ship's hull, expanding in all directions in the form of a cone, whose sides have an angle of practically forty-five degrees to the longitudinal axis of the ship.



Vertical and horizontal sections showing arrangement of water barrier, screens and vents for escape of the gases

One volume of a high explosive like T. N. T. develops about a thousand volumes of gaseous products of combustion, after cooling down to atmospheric temperature and pressure, but when the gases enter the ship and after they have expanded to a thousand times the volume of the original explosive body, they still have a temperature of probably about 5,000 degrees F. or 2,760 degrees C. Therefore, the quantity of heat which they contain is sufficient to increase their volume tenfold more. Thus the original volume of four cubic feet of explosive develops 40,000 cubic feet of gases.

How do we know that the gases have so high a temperature after having expanded to a thousand times the volume of the original explosive? Let us see:

If the mass of four cubic feet of explosive could, after detonation, be held within its original volume until cooled down to atmospheric temperature and instantly released, the gases would expand adiabatically to a thousand times their volume, and the work they would do upon themselves in the act of expanding would exactly equal the amount of heat absorbed from themselves to do the work of expanding; so that after they had expanded to a thousand times their original volume, they would still be at exactly atmospheric temperature.

Now, as we know that the amount of heat generated by the reaction of explosion of T. N. T. is sufficient to raise the temperature of the products of combustion to 5,000 degrees F. or 2,760 degrees C., we know that after the gases have expanded a thousand-fold they still will have a temperature of 5,000 degrees F., or 2,760 degrees C.

If a cubic foot of gas at atmospheric temperature and pressure be heated to 490 degrees F., or 273 degrees C. at constant pressure, its volume will be doubled; consequently, we know that for every 490 degrees of heat F., or 273 degrees C. which we add to a body of gas, it increases one unit volume; so that if a volume of gas be heated 5,000 degrees F. or 2,760 degrees C., under atmospheric pressure, it will be expanded tenfold.

Hence we know, à priorily, that if we can succeed, by means of water, in abstracting the excess heat of the gases of the explosive blast of a German torpedo as they enter the ship's hull, we shall decrease their volume from 40,000 cubic feet to 4,000 cubic feet. Not only this, but also if we can succeed in making the gases do work upon certain obstructions placed in their path, they will be cooled just in proportion to the amount of work that they thus do.

When a 1,000-pound projectile is thrown from one of our large 12-inch naval cannon, the striking energy of the projectile as it leaves the muzzle is about 50,000 foot tons. This represents sufficient energy to melt 750 pounds of cast iron. Consequently, the powder gases, in throwing the projectile from the gun, are cooled by just so much, that is to say, they give up enough heat in doing work to melt 750 pounds of cast iron.

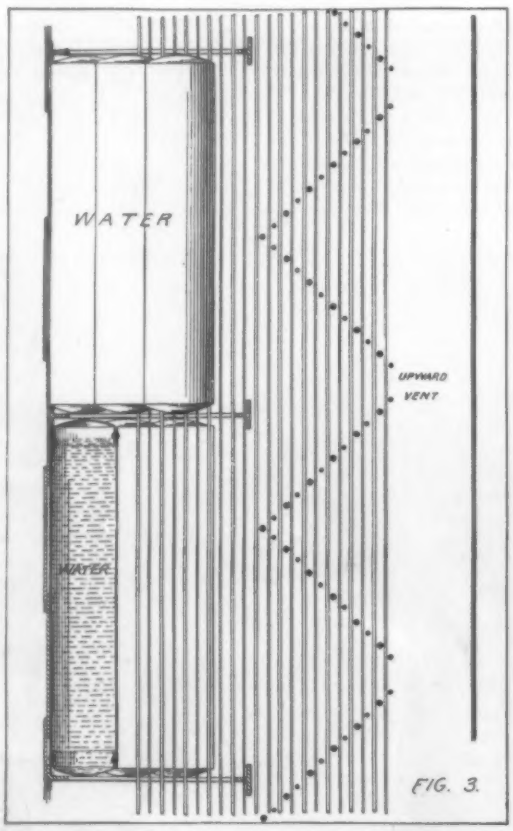
A strong, steel wire or round rod drawn taut and interposed in the path of the blast of a high explosive, offers very great powers of resistance, and it is very difficult to break such a wire or rod by the explosive blast. Consequently, if a screen composed of strong, steel wires or rods, be placed in the wall of a ship's hull in such position that it will receive the initial impact of the gases, it will place work upon the gases, and by wire-drawing and impeding them, dissipate a portion of their heat or energy and slow their velocity; and if the screen be so arranged that the gases strike it obliquely or a glancing blow, or in such wise that the shock upon the screen is less sudden and more gradual, then the screen will resist much better the impingement of the blast.

To this end I suggest placing a series of steel screens consisting of ¾-inch steel rods and ½-inch steel rods, alternating with one another in the positions and in the manner shown in the accompanying drawings.

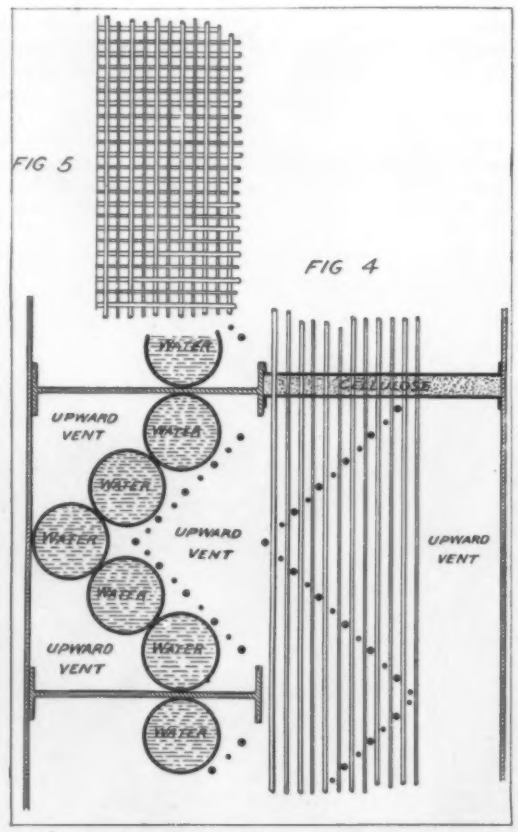
Although ¾-inch and ½-inch alternating rods are here illustrated, it is probable that ½-inch and ¼-inch or even smaller rods or wires will prove to be sufficiently large.

But in addition to the proposed screens, I purpose also to interpose between the seat of explosion and the screens a barrier or wall of water, so that the gases of explosion will carry forward with them a large mass of water against the screens, spraying and atomizing the water and mixing it intimately with the heated gases, thereby instantly lowering their temperature and volume tenfold, which means reducing their volume from 40,000 cubic feet to 4,000 cubic feet.

How do we know that the gases will give up their heat to the water-spray quickly enough and



Enlarged vertical section of water-cylinder barriers and screens for pulverizing the water



Elevation of screen and horizontal section of cylinders and V-shaped screens

completely enough to produce this result? Let us see:

Heat is given up from one body to another body at a rate equal to the fourth power of the difference in temperature of the two bodies and inversely as the square of the distance between the bodies, which rate increases directly in proportion to the amount of surface presented. Consequently, when water, whose specific heat is the highest of all substances, that is to say, whose capacity or greed for heat is the greatest of all substances, is sprayed by a flame-blast and intimately commingled with the gases, their heat is practically instantaneously absorbed by the water.

There are obviously different ways in which a water barrier may be interposed between the seat of explosion of a torpedo and the proposed screens. The simplest way, of course, is to construct a plain, external water-wall. But such an arrangement has certain disadvantages as well as advantages. Among the advantages are that such water-wall serves to direct more of the energy of the blast away from the ship's hull, rendering its effect upon the ship less intense in its local action.

But the continuous water-wall has the disadvantage that the two outer plates, or walls of the ship's hull immediately between the explosion and the ship's interior, are not so much shattered or fragmented by the blast as though a single wall unsupported by a backing of water were to be employed Therefore, saucer-shaped sections of both walls immediately at the seat of the explosion, somewhat torn and ragged-edged to be sure, but still several feet in diameter, are punched out of the ship's hull by the explosive blast, and forced inward, which result is not so advantageous for the purpose of dissipating the energy of the gases by means of a screen as though the wall were more completely shattered or broken up at the seat of the explosion.

Another disadvantage of the continuous water-wall is that the beam of the ship must be increased four feet or more in order to employ it, whereas by means of the water-wall or barrier which I recommend, the beam of the ship does not need to be increased. So long as the energy of the gases can be dissipated after entering the ship's hull, it is better that the action of the explosion should be localized as much as possible.

By the employment of the water-cylinder barrier which I propose, the skin plating of the ship, being unsupported by the water-wall, is more completely shattered and fragmented, while the fragments, being hurled against the water cylinders, are greatly retarded in their velocity, and the gases, having a chance to expand more before completing the demolition of the water-wall, carry with them a greater quantity of water against the screens, which is desirable, than would be the case if a continuous water-wall were to be employed.

Although the water-cylinders will be blasted away, still the V-shaped screens or barriers of steel wires or rods lying farther inship and behind the water barriers, serve effectually to arrest the flight of all fragments carried along by the explosive blast and to prevent them from piercing or injuring the walls of the ship's compartments. Furthermore, the spaces around and between the water cylinders effectually serve as vents for the escape harmlessly upward into the atmosphere of a considerable portion of the gases of the explosive blast.

As I have explained, when the explosion takes place on the outside of the ship's hull, the water surrounding the explosive, acting as a gun, and the ball of gases acting both as propellant and projectile, are hurled into the ship much in the same manner as though they were a solid projectile. Consequently, the gases would tend to punch a hole through a continuous outer water-wall in much the same manner that a solid projectile would do, largely parting the water from their path. Therefore, the gases would not carry forward with them against the screen such a large quantity of water as they would were a barrier composed of water cylinders employed like that which I propose.

As one less wall of the ship is needed through the employment of the water cylinders than with the continuous water-wall, and as the wall of the water cylinders will need to be only a sixteenth of an inch in thickness, and as no more metal is required for all of the water-cylinders than for a single wall or partition about three-eighths of an inch in thickness, no additional burden is imposed upon the ship by the weight of metal of the water cylinders.

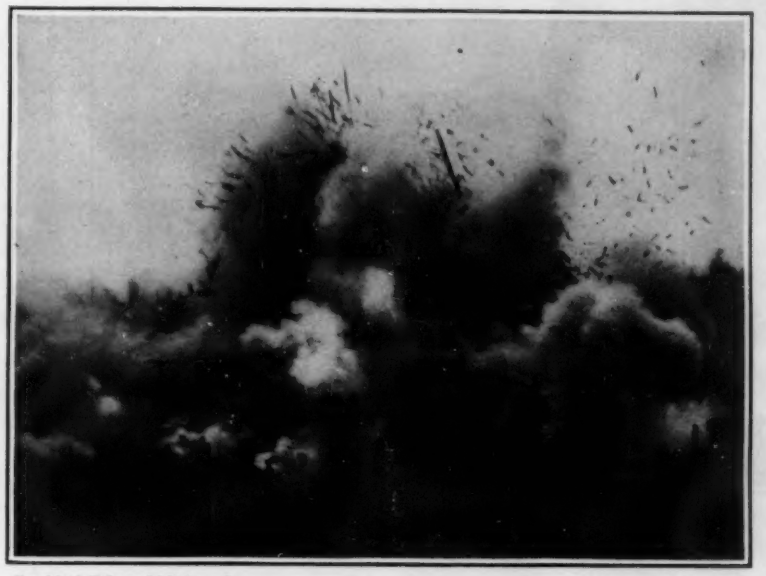
Armorplate a foot or more in thickness is frequently employed for the protection of the above-water portion of ships against shell-fire. It is equally important to protect the under-water portion of a ship's hull against torpedo attacks; and if we can secure the necessary protection with a device which will not exceed in weight armor of from three-quarters to even an inch and a half in thickness, we can well afford it.

Obviously, these water cylinders may be provided with suitable means for filling and draining them, and also with means for supporting them, which are details not necessary for me to present in this general statement.

When the explosive blast strikes and smashes the water cylinders, hurling the contents against the screens back of them, although the wires or rods of the screens will not be broken, they will still be forced back and basketed somewhat, and will be correspondingly stretched or drawn. The wires or rods of the longitudinal inner screen are made to pass through a double wall supporting them, whose inner space is filled with cellulose, so that in the event of water working through, the cellulose will be swollen and will prevent the passage of the water through the barrier into the next compartment.

In order to give the wires or rods of the screens in-

(Concluded on page 584)



Copyrighted, Underwood & Underwood

This explosion of a mine under a German concrete redoubt represented three and a half days of strenuous tunneling work on the part of the Canadian sappers

Copyrighted, International Film Service

Before this seaplane can leave the surface of the water it must develop a speed over 60 miles per hour, because of its small wing surface

Copyrighted, International Film Service

The new Burgess seaplane scout. In the background may be seen two flying-boat hulls which are left out in the open for several weeks to test their seaworthiness

With the Soldiers Who Fight Underground

ALTHOUGH mining as a military operation is several centuries old, in the present conflict it has been developed into a highly effective means of attack when carefully coördinated with infantry assaults. The machine gun particularly is responsible for extensive mining operations as an alternative for intensive artillery preparation, in this war.

Mining operations have at times developed into commendable engineering undertakings on the Western front; indeed, these operations have been nothing short of stupendous in some instances because of the difficulties to be overcome and the obvious lack of equipment with which to carry on the work. On several occasions the Entente sappers have driven tunnels of considerable length under "No Man's Land" toward the enemy works; and on at least one occasion these tunnels have been over a mile in length. After the explosion of the mine charges craters have been formed which could readily accommodate a six-story building so that its roof would be level with the surrounding ground.

Underground warfare, or mining, is not devoid of adventure; in the first place, one is never alone in his activity. While a tunnel is being driven toward the enemy lines, the enemy is usually driving a tunnel toward one's lines. Thus it becomes a question of completing one's tunnel first and of foiling the enemy's efforts. To achieve the latter end various devices have been drafted into the service of the sappers for the purpose of detecting and locating enemy mining operations, among them a modified form of stethoscope of the type depicted in our cover illustration, and super-sensitive electric microphones. With these devices a trained listener is usually able not only to detect enemy sappers at work, but also ascertain within a few feet the location of their tunnel. And with the discovery of the enemy's whereabouts it becomes a comparatively simple matter to drive a counter-mine or *camouflet* toward him and explode a charge, which generally proves fatal to the enemy and his work—provided he is caught unawares.

Much depends upon the sapper, both for offensive and defensive operations, in modern trench warfare; and the battle underground is a continuous struggle between the brawn, skill and wits of the contending forces. The service is as hazardous as any to be found on land or water or in the air, for at any moment the sapper is apt to be blown to pieces or buried alive by enemy counter-measures. Yet volunteers for this service appear to be plentiful, and whenever armies settle down into entrenched positions the underground soldiers are sure to begin their exciting battle.

Speeding up the Flight of the American Seaplane

FOLLOWING fast on the heels of the aeroplane, the seaplane is being constantly improved upon with the object of making it a faster and a more rapid climbing machine. Obviously, the seaplane, because of the great head resistance of its pontoons, cannot begin to approach the speed and the climbing capabilities of its land counterpart, yet nevertheless much has been accomplished in this direction of late. Indeed, the seaplane of today is considerably faster than the aeroplanes of a year or two ago.

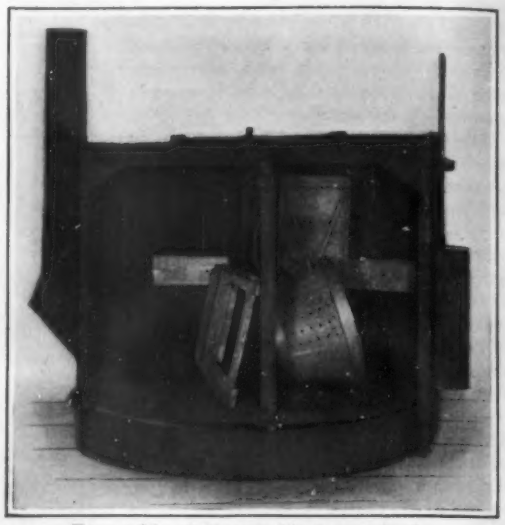
At a leading aeroplane factory at Marblehead, Mass., work is going on night and day in order to turn out machines for the United States Government and the Allies. At the present time there are twenty-eight machines under way for our own Government, and three huge seaplanes for the British government fast approaching completion. Among those for the United States is one, an odd type, which is to be used as a scout and which is undergoing a series of tests. This seaplane, which is shown in the accompanying illustrations, carries only one man, the pilot. Because of its small wing surface it must develop a speed of something like 60 miles an hour on the water before it can take to the air. It is not known what speed the new seaplane will make in the air, although a study of the accompanying illustrations discloses what appears to be a most effective streamline design and a pronounced effort to eliminate guy wires, all tending toward high speed.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

Screen window and rubber-lined slot of new blast-room

Rear view of the new blast-room, with parts ready to be treated



Turn-table of the new blast-room in the half-way position

A Sand-Blast Room Built on the Revolving Door Principle

NO matter how well clothed and helmeted the operator may be, it is fast coming to be a recognized fact that the sand-blaster is best protected when he is not in the same room as the articles being treated. Typical of the latest advances along this line, then, is the sand-blast room shown in the accompanying illustrations, which permits the work to be viewed by the operator who stands in front of a fine-mesh screen window, playing the hose through a soft rubber slit.

The new sand-blast room is built on the revolving-door principle; that is to say, the platform on which the work is placed is mounted on a pivot so that it can be swung around. It will be noted that the platform or table is divided in two by a center partition or wall, so that when the work is placed on one-half of the table it can be swung around so as to form a room with the front part of the apparatus, leaving the other half exposed, ready to receive other work. When the first lot of work is finished, the table is given one half turn, bringing the finished work out and introducing the new work into the chamber.

The sand-blast nozzle is inserted through an opening covered with a strip of soft rubber that is split horizontally, and in this manner the operator can move the nozzle about freely, while the soft rubber members fold about the hose and prevent the escape of sand. Two special lamps provide illumination, and the operator can see the condition of the work by looking through the wire-screen window. In order to keep the window free from dust at all times, an exhaust fan connected with the room draws air in through the screen in the upper portion of the front wall.

Being provided with a grate-like floor, the sand introduced into the blast-room passes through the floor and into a recovery tank located in a pit under the room. From this tank the sand is discharged by gravity into the sand-blast line and is conveyed to the nozzle by air pressure, thus repeating the cycle of operations.

Making the Railroad Switch Right Even When It Is Wrong

A FACING-POINT switch is a potential source of danger to any railroad, and for this reason it should be avoided whenever possible. However, there are so many instances where the facing-point switch must be used, particularly on single-track roads and many double-track roads, that it has come to be looked upon as a necessary evil which must be mitigated, not so much by greater or less elimination as by some sort of modification.

A number of railroads have lately been experimenting with a modified facing-point switch, which, according to reports, appears to have solved the problem in large measure. Literally, the new switch is always right even when it is wrong; in other words, the new switch prevents derailment even when the switch points are out of place.

Those familiar with the operation of the spring rail frog will note in the accompanying line drawings that the present switch is the application of the same principles, only in this case they are applied to a switch point instead of to a frog. In short, a spring point is introduced in back of the standard switch point, which allows the wheels of a car to return to the main line if they foul the points in running against them.

It will be seen in the accompanying illustration of the new switch installed at the Union Depot Yards at St. Paul, Minn., that the points of the switch rails are set neither for the main nor the siding. Obviously, should a train approach a switch in this position, it would soon drop on the ties and, if it were traveling at a high rate of speed, a serious wreck would result. And the points could take such a position either by the lever of the switch-stand not having been shut down in the notch, or by the breaking of the connecting rod or its bolts, or again by the points becoming worn, so that a sharp wheel flange could tear them open. Besides these there are other causes that could result in the misplaced points, both freakish and otherwise.

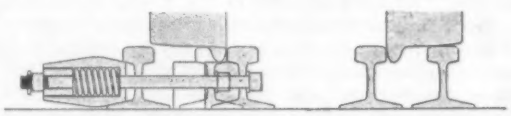


Fig. 2—Arrangement of the switch members through the section *A A* of the plan view

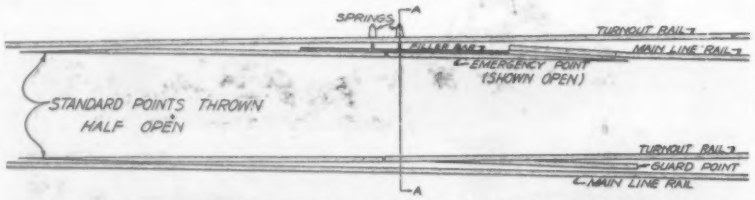


Fig. 1—Plan view of the new railroad switch, showing its principal members

Even though the points of this newly-invented switch are set midway, a train passing over it will not be derailed

Nevertheless, with the new switch in use no derailment would occur under these circumstances, according to the inventors, because the wheels would at all times be on the rails and find their way to the right rails without mishap.

Utmost simplicity marks the new switch; for, in addition to the parts of the standard switch, it consists primarily of an emergency point butted up to the heel of the standard point on the left-hand side facing the switch, as shown in Fig. 1. This and the standard point are fastened together by a filler bar bolted to the outside of the points, which bears on the tie plates as it partly carries the wheel load when the emergency point is opening.

The emergency point is kept in position by two springs at the heel of the points and another pair of lighter springs at the point of the emergency point, which keep the point tightly shut against the main-line rail at all times, but allow the point to open for passage of the wheels. When a train is passing through the emergency point at a slow speed, the guard point is necessary in the right rail, but under moderate and high speeds this guard point is not used for reasons that will be explained.

Referring to Fig 2, it will be noted that the left-hand wheel is riding on the filler bar on its flange, while the right-hand wheel is riding on the ball of the rail on its tread The diameter of the left-hand wheel being the greater of the two, it naturally tries to go faster, but since the two are rigidly mounted on the same axle the left-hand wheel cannot outstrip the speed of its companion. However, it remains a force that is striving to force the wheels to the main tracks. This can be demonstrated quite readily by taking a wooden spool and cutting down one end smaller than the other, and then rolling it along the floor. The spool will be found to roll in a circle. This, then, is precisely what the railroad wheels are attempting to do, and, as a result, the left-hand wheel forces its way through the emergency point rather than waiting to be pulled through by the action of the right-hand wheel on the guard point.

It will now be understood why it is that when a train approaches a facing-point switch equipped with the emergency point and in the position shown in the illustration, one wheel will try to follow the side track while the other is trying to take the main line; but through the agency of the new features, the left-hand wheels will ride on the filler bar, and, as the emergency point opens, will return to the main line without jar or damage to the train.

A further addition to the new switch, which, however, is not shown in the illustrations, is a trip and detector bar arranged to throw the points open after a train has taken a siding, so that the following train will pass through the safety point instead of running into the train standing there, should it happen that the switch has been neglected and has not been set back for the main line.

Why buy a 5-ton Truck if your Loads are Sometimes only 2 Tons?

TODAY, concerns who have figured hauling costs and methods on an expert basis are not buying 5-ton trucks just because *occasionally* they have a 5-ton load to carry. Nor are they buying two 2-ton trucks because sometimes they have four tons to haul.

Expensive Hauling

Thousands of truck owners are cutting their hauling costs as much as 50 per cent, and even more, by using TROY Trailers. They use trucks alone when loads are small. When loads are larger they simply attach a TROY Trailer. When they have loads to take to two destinations they put one on the truck—the other on the TROY Trailer. Leave the Trailer at the point to be unloaded—and perhaps reloaded. The truck goes on to its destination — then picks up the Trailer on its return trip.

Firms who never before used trucks are now buying trucks and TROY Trailers. They find the combination more than doubles their hauling capacity, yet the operating cost is only 10 per cent more than with the truck alone.

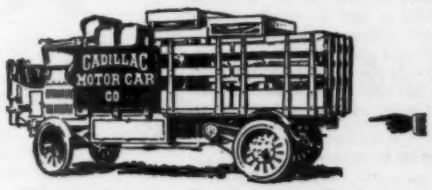
"Troy Trailers"

The REAL CAPACITY of any truck is not only what it can carry, but, the fact that it can CARRY its full rated capacity, and PULL as much again, and more, at the SAME TIME.

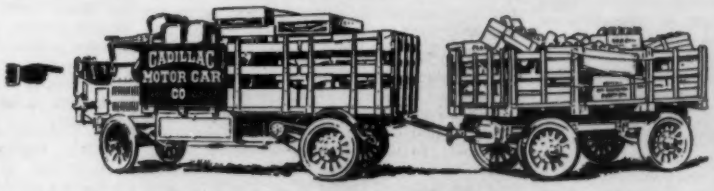
TODAY, where a concern has loads averaging around two tons, they buy a 2-ton truck. This means that their cost of delivering a 2-ton load is only the cost of operating a 2-ton truck. They are thus keeping their operating expenses DOWN by always keeping their loads UP.

And, to meet the requirements of transporting LARGER loads, they are purchasing TROY Trailers. They have learned that the capacity of a truck is not what it will CARRY, but its REAL CAPACITY is what that truck will carry, when fully loaded, with what it can also PULL at the SAME TIME.

The way the Cadillac Company does it—



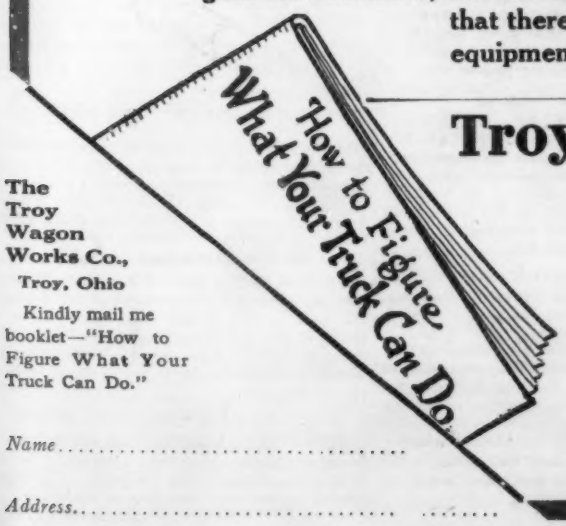
The Cadillac Motor Co. uses a 5-ton Troy Trailer in connection with their 3½-ton Reliance Truck. They use their truck alone when the load is so small that the truck can take care of it, but—



—when their loads are larger, they simply attach a 5-ton Trailer. This was the second Troy Trailer they purchased, "on the strength of the efficiency of the first one." Automobile companies certainly know how economies can be affected.

"We have just purchased the second Troy Trailer on the strength of the efficiency of the first one. We are using this 5-ton Troy Trailer in connection with a 3½-ton Reliance truck. When both truck and trailer are loaded it makes a total of 8½ tons. As to the extra gasoline consumed, and increased wear on the tires of the truck's rear wheels, we do not figure that there is any perceptible increase of cost. We expect to add more equipment of this nature at an early date."

Cadillac Motor Co.



The Troy Wagon Works Co.,
Troy, Ohio

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Name.....

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Troy Trailers can be operated with any good truck

TROY Trailers are made in capacities from 1 to 5 tons, and with any type of body. They are built for use as a single Trailer, or in trailer trains. They are reversible, therefore can be backed up to any loading platform, or backed into any alley, as easily as if they were being moved forward. We also make a complete line of trailers of smaller capacity to be operated with small trucks or pleasure cars.

The Troy Wagon Works Company
Troy, Ohio
Branches or Distributors in all principal cities

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of SCIENTIFIC AMERICAN.

Pertaining to Apparel

DIAPER.—SALLIE W. LAING, 2703 Fairfield Ave., Shreveport, La. This invention provides a diaper which when in use gives the desired comfort to the infant, thoroughly protects the abdomen without being unduly bulky and allows perfect freedom of the legs. It also provides a removable absorption pad which can be readily removed without removing the diaper.

Electrical Devices

CONTROLLER FOR INDICATING SYSTEMS—A. ZEISEL, care of Zeisel Electric Co., Bel Air, Md. By means of this controller indications can be given manually through the movements of the handle to various positions depending upon the indication desired to be given. By means of this device the current supplied to the indicator may be cut off under normal conditions, thus minimizing current consumption and also preventing heating of the indicator

Of Interest to Farmers

MAIZE HARVESTER ATTACHMENT FOR WAGONS.—J. W. DICKEY, Olustee, Okla. This inventor provides a harvester especially designed with respect to harvesting milo maize, and other grain of the sorghum family, which grows at uneven heights from the ground, the device being so constructed as to be attached to an ordinary farm wagon and without the requirements of special tools or skilled workmen.

Of General Interest

CUP HOLDER.—F. S. EASTON, 136 Forest St., Stamford, Conn. The improvement pertains to devices for holding a form of spitto n known as cups in hospitals, and has for an object an arrangement which will properly hold the cup in position for use while allowing the same to be swung at any time out of the way.

METAL WINDOW.—E. FLAGG, 109 Broad St., New York, N. Y. This invention provides a fireproof window which will give a larger light opening than the ordinary metal windows by decreas ng the size of the window frame and fitting the window sashes over the frame; and which window structure is weatherproof.

PERCUSSION FUSE.—K. J. GIRDWOOD, 464 Chestnut St., South Bethlehem, Pa. This invention refers to fuses adapted to be inserted into the points of high explosive shells to be shot from a cannon, and provides such fuses which will cause the shells to explode if they graze an object enough to slightly retard their flight, as well as when they strike the ground or an object fair y to stop their flight.

EDUCATIONAL DEVICE FOR TEACHING READING.—V. M. HILLYER, Calvert School, West Chase St., Baltimore, Md. This invention relates more particularly to devices for teaching reading, and provides a device to teach reading by sound, to train a child to recognize automatically the sounds of combinations of letters, called phonograms, that form the elements of all words, and thus to give him the key to reading and enable him in the shortest time to read new matter independently and easily.

CLIP FOR NECK YOKES.—W. J. CASS, Easton, Maine. This improvement provides a clip for neck yokes arranged to strengthen or reinforce the yoke bar, to permit of securely fastening the clip in position on the yoke bar without weakening the latter, to securely hold the pole ring in position, and to present no undesirable projection to the pole.

MOLD FOR MAKING DENTAL CROWN DIES.—S. W. TALIAFERRO, 1219 Wheeler Ave., Bronx, N. Y. In this case the invention relates to dentistry, and its object is to provide certain new and useful improvements in mold for the making of dental crown dies whereby the dentist is enabled to quickly and accurately shape the crown to fit the patient's tooth to be crowned.

ARTILLERY PROJECTILE.—E. R. WATSON, 1101 Division St., Indianapolis, Ind. This inventon relates particularly to heavy artillery, and provides a projectile which, at a predetermined time after having been discharged from a gun, will itself discharge a plurality of explosive shells simultaneously and preferably, over an area much greater than would be possible if the projectile were of the usual explosive type.

Hardware and Tools

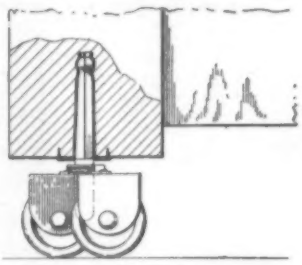
FLEXIBLE COUPLING.—C. E. TOWNLEY, Dryden, N. Y. One of the jaws with which one of the coupling members is provided is moved away from its companion jaw by the movement of an encircling collar in one direction and against the tension of a spring, the movement of the collar in the opposite direction serving to move the jaw in the direction of its companion member. A key is used to force the collar back to open the jaw, means being provided to lock the key against the collar with the jaws in open position.

Household Utilities

SAFETY CHAIR FOR WINDOW CLEANERS—L. CHOLET, 2821 Briggs Ave., Bronx, N. Y. This improvement refers to safety appliances for windows or the like and has particular reference to a portable device in the nature of a chair or seat adapted to be applied at or upon window sills in succession for supporting a window washer while washing the outside of the windows.

HYGIENIC TOILET SEAT COVER.—MARIE BLOCH, 1391 Madison Ave., New York, N. Y. This invention provides a comparatively cheap but effective covering for a toilet seat adapted for general use, and while it is intended primarily for use in public places, its use is also adapted for private residences as well as elsewhere. It provides a sanitary covering of the nature set forth of a construction adapting it to be automatically retained in place in use.

CASTER.—H. MARTIN, 610 Houser Bldg., St. Louis, Mo. This invention provides a caster especially adapted for use with articles of furniture, wherein two wheels are provided, mounted



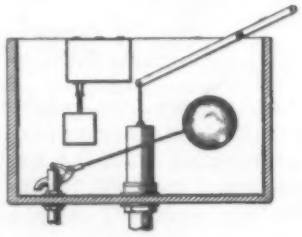
FURNITURE CASTER

one in advance of the other, and connected to the furniture to rotate on a vertical axis, midway between the wheels and midway between their axes of rotation, and near the level of said axes to prevent sticking of the caster when turning.

FOLDING BED.—M. COX, 651 3d Ave., New York, N. Y. This invention provides a folding bed which is simple and durable in construction and arranged to permit of easily moving the bed into extended position for use or folding it to take up comparatively little room when not in use and without presenting an unsightly appearance.

IRONING BOARD.—W. B. BEHNKE, Ashland, Wis. The board may be collapsed into small compass for transportation or storage or extended to provide a smooth, plane horizontal table for use in ironing garments, and extending beyond the supporting frame at one end thereof, and having a detachable bosom board supported by the first-named board above the same, and with one end free, the boards being hinged to the frame, and the hinge connection being detachable.

DISINFECTANT APPARATUS.—S. BICKERTON, P. O. Box, 13, Honolulu, Hawaii. The invention relates to disinfectant apparatus for toilet tanks, and provides an apparatus whereby a certain amount of disinfectant will be automatically fed to the tank to become mixed with



DISINFECTANT APPARATUS

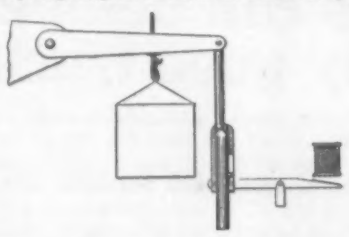
the water in the tank when the valve of the tank is operated, to permit of a quantity of water flowing therefrom to the bowl. It provides a device automatic in operation and wherein the quantity of disinfectant flowing therefrom may be readily regulated.

FLUSHING TANK VALVE.—R. HODGSON, 100 Sherman Ave., Elm Park, S. I., N. Y. Among the principal objects which the present invention has in view are: to provide an inlet valve having a seat located outside the tank and removable therefrom; to avoid leakage of valves used in connection with a flushing tank; and to simplify the construction of valves of the character mentioned.

Machines and Mechanical Devices

MULTISTAGE COMPRESSOR.—N. J. PARKER, 114 8th St., Lincoln, Ill. This invention provides a compressor having two series of multiples united by a pressure governor; provides a compressor in which the motive power driving the compressor is controlled through the medium of the predetermined maximum pressure generated by the compressor; and provides a pneumatically-operated mechanism which will operate rapidly when coupling or uncoupling the compressor from the motive power.

RELEASING DEVICE.—W. C. KOCH, 706 Capital Bank Bldg., St. Paul, Minn. Among the objects of this invention is to provide temporary holding mechanism for the purpose of sustaining heavy weights, great forces, or the like, or tempor-



RELEASING DEVICE

arily holding back any piece of mechanism in a restrained position, the holding device when in set position serving to effectively secure the weight, force, or mechanism, but being of such nature as to be easily tripped or released at the intended time.

METHOD OF FINISHING BALL BEARINGS.—F. STARIN, 304 N. Main St., Springfield, Mass. The main object of the present invention is to provide a method for finishing ball bearing rings. Each ring, although having four faces to be finished, is mounted upon the same chuck twice only. The finishing process is, therefore, less expensive than those heretofore resorted to. As the chucks are seated in the grooves formed in the rings, the already polished faces thereof cannot be injured.

GRANULATING MACHINE.—E. A. WALTERS, R. D. No. 2, Youngstown, Ohio. This invention is an improvement in granulating machines, and provides a machine of the character specified, especially adapted for granulating open hearth and blast furnace slag as it comes direct from the ladle, and delivering it prepared and ready for use.

Prime Movers and Their Accessories

INTERNAL COMBUSTION ENGINE.—R. C. WINCHESTER, care of Winchester & Wilhelm, Box 238, Palmetto, Fla. Among the numerous objects of this invention may be mentioned the provision to eliminate the necessity for base compression, by using instead the compression of a pump employed for this purpose; the provision of means in connection with the pump to develop and maintain a volume of air under pressure, and serving the purpose of an air spring, to balance the engine thrust in the sense of relieving the connecting rod and various other rapidly-moving parts from undue strain at the lower end of the down-stroke; and the provision of means for circulating around the cylinder, the water used for cooling the jacket.

HYDRAULIC CLUTCH.—W. L. ROUNDS, 1764 Belleview Terrace, Rensselaer, N. Y. In the present patent the invention has reference to clutches, and particularly to those of the hydraulic type, and is especially adapted to be used between driving and driven members when a simple, automatic and reliable clutching of the shafts is desired.

Railways and Their Accessories

AUTOMATIC TRAIN STOP.—C. C. BOWMAN, 1105 Temple St., Hinton, W. Va. This invention prevents a train from proceeding by one of the usual automatic block signals without stopping, the invention embodying a locomotive carried mechanism, and a track side mechanism, the latter being connected to the usual automatic signal and being moved to operative position by the lowering of the signal arm to danger position, and the locomotive carried mechanism being such as when actuated by the track side-mechanism in operative position, it bleeds air from the train line and causes the brakes to be applied the same as if the engineer's brake valve were manipulated to this end.

COMPARTMENT SLEEPING CAR.—E. FLAGG, 109 Broad St., New York, N. Y. An object here is the elimination of upper berths whereby the objectionable features and the discomforts incurred on the use of the upper berth are eliminated, not only without decreasing the berth capacity of the car, but a gain in floor space between the berths is obtained.

LATERAL MOTION TRUCK BOLSTER.—J. J. SULLIVAN, Supt. of Machinery, N. C. & St. L. Ry., Nashville, Tenn. This invention provides a truck bolster which while permitting limited lateral play of a car or tender, serves under normal conditions to retain the center-plate supporting the car or tender bolster at the center line, and thereby hold the car or truck in place. Mr. Sullivan has invented another lateral motion truck bolster which while permitting a limited lateral play of a car or tender, serves not only to retain the center-plate normally at the center line, but also tends to increase the resistance to an abnormal movement of the car or tender.

Pertaining to Recreation

TOY.—H. E. HUMBERT, care of Baker & Bennett Co., 873 Broadway, New York, N. Y. This invention relates to toys and deals particularly with the packing of the toy in such a manner as to display one of its uses, as by utilizing certain of the blocks to represent a figure. The packing affords the best display of the blocks at a counter, show window or other places, and indicates immediately the purpose of the set of blocks.

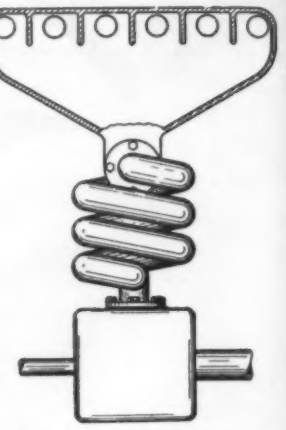
GRASS-PLOT FOUNDATION.—W. H. TUCKEN, 35 Nassau St., New York, N. Y. The invention relates particularly to a foundation construction for golf putting greens capable of use in many climates, particularly in a southern climate. It provides a construction whereby a desirable grade of grass may be grown which is especially good for golf putting greens.

Pertaining to Vehicles

FENDER FOR VEHICLES.—H. SHIIHARA, 604½ Sixth Ave., Seattle, Wash. This inventor provides a fender with means for attachment to the axle of a wheel-supporting structure; provides means for at will elevating the fender to avoid obstructions incident to the road; and provides means for avoiding wrecking the fender when disposed in service position.

DIRECTION INDICATOR FOR AUTOMOBILES.—R. J. MILLER, Ensign, U. S. Navy, U. S. S. Albany, Hampton Roads, Va., and J. BELL. Address the former. The invention relates to a safety signal for automobiles, of that type known as safety signal for automobiles, of that type known as a direction indicator for giving a warning as to the direction of turning or the stoppage of an automobile to the drivers of other automobiles, or to pedestrians, whereby accidents can be avoided and the driving a car rendered safe and nervous strain and worry on the part of the driver minimized.

SPRAY DISCHARGE EQUALIZER.—F. CALDWELL, 7510 Cornelia Ave., Carthage, Cincinnati, Ohio. This invention relates to fuel-gas equalizers or receptacles in which the gases are intended to be uniformly mixed and discharged into the power-cylinders of automobile or like engines using gas, gasoline or kerosene or



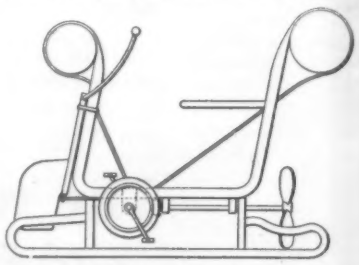
SPRAY DISCHARGE EQUALIZER

other combustible liquid fuels. The engraving represents a longitudinal section of the equalizing-receptacle shown surmounting an inlet, secondary mixing-coil, which latter is in elevation and also surmounts the ordinary carbureter or primary mixing-chamber, gas and air intakes being shown in connection with the carbureter.

DRAFT APPLIANCE.—J. M. MILLER, Millersburg, Ohio. This improvement provides a draft appliance in the nature of a hitch for a single horse which may be used in conjunction with a multiple horse draft device such as a two- or three-horse double-tree, the device presenting advantages in convenience of arrangement, and advantages of reversibility whereby it may be applied either to the right or left-hand side of the vehicle tongue.

DEMOUNTABLE RIM.—C. R. RAGSDALE, 6144 McPherson St., St. Louis, Mo. This improvement has reference to demountable rims for the wheels of automobiles and other vehicles, and more particularly to that type of demountable rim having means whereby to detach the tire from the demountable rim without removing the rim from the wheel.

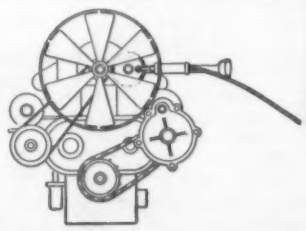
FLOATING BICYCLE.—P. KRAEMER, 185 New York Ave., Jersey City, N. J. This invention relates to means whereby a person may be supported and propel himself in water, and the main object is to provide such means which will



FLOATING BICYCLE

insure that the greater part of the body of a user will be beneath the surface of the water. Among other objects, one is to provide such devices which may be used for the saving of persons from drowning, which furnish great sport and which may be used in speed contests.

PUMP OPERATING MECHANISM.—H. O. BUTLER and W. B. JENNINGS, Franklin, Ind. This invention facilitates the inflation of the tires of a motor vehicle by operating an air pump by mechanism actuated through the engine of the



PUMP OPERATING MECHANISM

vehicle and including a portable pump supporting member of novel construction, carrying a rotary element driven by a movable part of said engine, to operate said pump, the latter being adapted to be connected to any of the tires of the vehicle wheel.

Designs

DESIGN FOR A GOBLET.—W. E. HUNTER, care of Economy Tumbler Co., Morgantown, W. Va. In this goblet the design shows an article of graceful though somewhat conventional lines, except at the base of the bowl which develops into an additional tapering yet swelling curve on joining the stem.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of patentee, title of the invention, and date of this paper.

LEGAL NOTICES

Submarine Problem—II

(*Concluded from page 573*)

very much as any other surface ship would be. It is provided with wireless carried on two masts which can be quickly folded down and lashed on deck. In the submerged condition the captain for vision has to depend on two periscopes, one terminating in the conning tower and the other to the operating room below. The gyroscopic compass is provided with tell-tale repeaters on the bridge, in the conning tower, and in the observation room.

The best description of the interior of a German submarine is that given by Mr. Reuterdahl in our issue of February 10th. His observations, drawings and sketches were made aboard the "Deutschland," and the general arrangement of the plant and the method of operating is the same on the merchantship as on the military U-boats. From Captain Koenig this authority learned that the German fighting submarines are always maintained in condition ready for submergence, the removal of the repeater compass and the closing of the hatch door being all that is necessary.

Seeing and Hearing Below Water

When the submarine is below the surface of the sea it still has its eyes above, these eyes consisting of the two periscopes with which it is able to obtain a very clear view of what is going on above water. The periscope consists of a vertical tube which extends from a few feet above the surface to the interior of the submarine. German boats carry two periscopes which, by means of suitable gear, can be raised above the surface of the water for observation, while the submarine remains secure below. At the top of the tube is an object glass; at the bottom an eye piece. Two reflecting mirrors, one at the top and the other at the bottom of the tube, cause the image to be transferred from the object glass to the eye piece. The operator can turn the telescope so as to sweep the whole horizon. At greater depths when the periscope is submerged, the submarine is blind and it must be navigated by dead reckoning—that is, by compass and clock, and by count of the revolutions of the propellers. When the submarine is submerged, periscopes and all, it is necessary to substitute hearing for seeing, and to this end some very ingenious apparatus has been devised. The most common of these are the microphone listeners, which are attached, one on each side of the boat and connected by wiring to a pair of telephones. The throb of the engine and beat of the propellers of a distant ship can be heard, and its bearing from the submarine ascertained with a fair degree of accuracy.

How the U-Boat Looks Inside

The accompanying drawing by Mr. Reuterdahl gives a realistic impression of the interior of a U-boat at sea. The view shows the central operating compartment; in this case with the captain at the periscope. Usually, this is not the captain's station, the engineer of the submerged vessel being stationed at the periscope, and the captain in the conning tower. The two men to the left operate the gear which work the forward and aft diving rudders, and in front of them are dials which show the depth below the surface. The man at the horizontal wheel at the right is the helmsman; in front of him are the gyroscopic compass and the tell-tale. The operating compartment holds seven men, and here are to be found the switches for controlling the motors, the ballast tank manifolds, air manifolds, and indeed all the machinery for the control of the boat. The question of ventilation has been well worked out, and although the air within a submarine especially during long periods in a submerged condition, is not all that is to be desired, the conditions are not unbearable. In the first place, there is a sufficient volume of fresh air within the boat when she first goes down to supply the crew for a great many hours, and the air is renewed by admission of fresh air from the compressed air tanks, the valves of which are left slightly open, so that a small, but steady, stream of fresh air

is continuously flowing into the boat. The air is also purified by the use of chemical substances which absorb the poisonous gases of the vitiated air. It is possible for a submarine to remain submerged from twenty-four to forty-eight hours without entailing upon the crew any inconvenience so far as respiration is concerned.

How to Make Ships Torpedo-Proof

(*Concluded from page 579*)

creased elasticity or stretch, rings may be employed in certain positions or at certain distances, which, by being drawn into a long loop-shape under a pull less than the tensile strength of the rods, will give the rods any required degree of elasticity, if such should be found necessary, which to my mind is doubtful. The inherent elasticity of the metal of the rods themselves I think will prove sufficient

Spaces are provided upward through the ship's deck for the free escape of the gases Of course, such openings will obviously be closed by suitable hatches, which will be thrown open by the gas pressure under them in case the ship is torpedoed, all of which is illustrated by the accompanying drawings.

My method of torpedo-proofing ships is applicable to hulls of any form, and it is not necessary to alter the lines of the hull requisite for speed, or to increase the beam or draft of the ship materially, if at all, for the purpose. The water cylinders of the barrier may be utilized to carry oil on the outward trip and be filled with water for the return voyage.

Although oil would not serve as well as water as an absorbent of the heat of the gases of the explosion, still oil could be made to serve the purpose by making the cylinders somewhat larger.

An important advantage of my system of torpedo-proofing ships is that it may be applied to ships already built. For example, the freight and passenger ships taken from Germany could in a short time be rendered torpedo-proof by my method, and although their beam and displacement would necessarily be somewhat increased, still their speed would not be greatly reduced.

It seems to me highly important that any torpedo-proof ship, or ship intended to resist torpedo attacks, should have a speed greater than that of the German U-boats—at any rate, much greater than their underwater speed, in order that a U-boat might not be able to follow the ship and repeatedly torpedo it. The torpedo-proof ship would, of course, be armed with guns, which would render it impracticable for a submarine to follow it except when submerged

I have not attempted to show the interior construction of a ship, such as the arrangement of boilers, engines, bulkheads and so forth, for such construction of a ship's hull has already been very scientifically worked out by the Navy Department.

I may suggest, however, that it might be advisable to divide the interior space of the hull into a larger number of water-tight compartments than is usual, with no passages between them. For example, a longitudinal, central bulkhead should run the whole length of the ship, and cross-sectional bulkheads should be employed every twenty or thirty feet, and without connecting passages

It would be necessary, of course, that freight should be lowered and raised through hatchways from each compartment independently. If, however, freight can be safely carried and in large quantities in a ship of such construction, a little added inconvenience in handling it ought not to count for much.

Oklahoma Bureau of Standards

THE State of Oklahoma has established a bureau of standards, with an initial appropriation of $8,500 to purchase equipment. The bureau proposes to acquire primary and secondary standards of weights and measures, and facilities for testing gas, water and electric meters. Fuel tests are also contemplated. The bureau is situated at the University of Oklahoma.

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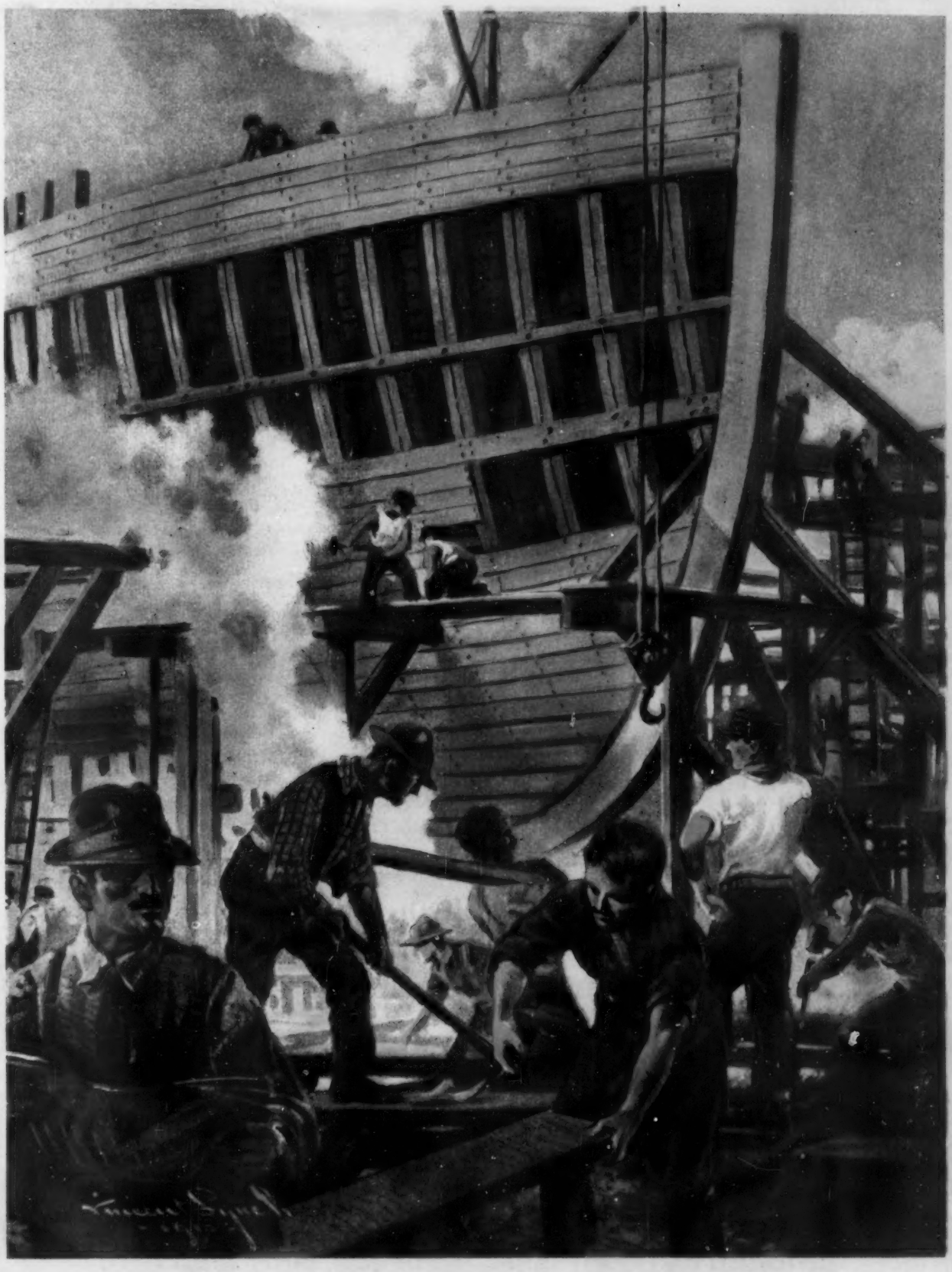

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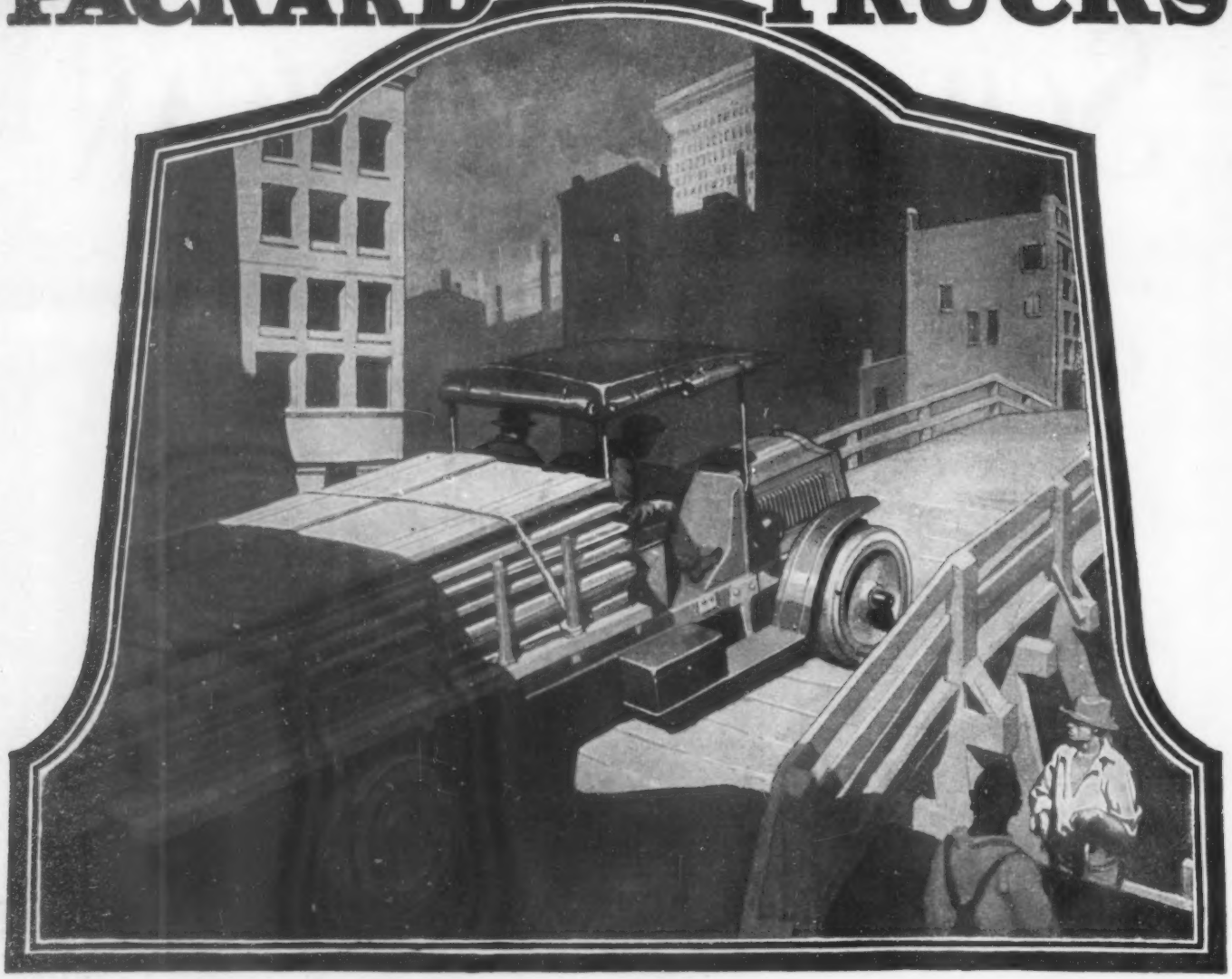

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